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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. **ST9-99-115** Total Pages **124**
First Named Inventor or Application Identifier
Terry Michael Bleizeffer
Express Mail Label No. **EL409135686US**

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

Assistant Commissioner for Patents
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Washington, DC 20231

1. ☒ Fee Transmittal Form
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2. ☒ Specification [Total Pages **47**]
(preferred arrangement set forth below)
- Descriptive title of the Invention
 - Cross References to Related Application
 - Statement Regarding Fed sponsored R & D
 - Reference to Microfiche Appendix
 - Background of the Invention
 - Brief Summary of the Invention
 - Brief Description of the Drawings (if filed)
 - Detailed Description
 - Claim(s)
 - Abstract of the Disclosure
3. ☒ Drawing(s) (35 USC 113) [Total Sheets **28**]
4. Oath or Declaration [Total Pages **6**]
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- b. ☐ Copy from a prior application (37 CFR 1.63(d))
(for continuation /divisional with Box 17 completed)
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☐ Continuation ☐ Divisional ☒ Continuation-in-part (CIP) of prior application No.: **08/949,636**

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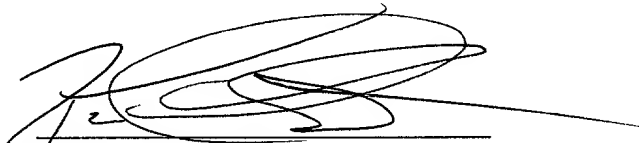
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I hereby certify that this patent application in the name of Terry Michael Bleizeffer, Tanya Couch, Catherine Elizabeth Wuebker Drummond, Virginia Walbridge Hughes, Jr., Theresa Hsing Lai, Joseph Davis Lea III, and David Harold Oberstadt for SYSTEM AND METHOD FOR FILTERING QUERY STATEMENTS FROM MULTIPLE PLANS AND PACKAGES ACCORDING TO USER-DEFINED FILTERS OF QUERY EXPLAIN DATA, together with the drawings, a Utility Application Cover Sheet, a joint signature Declaration, Power of Attorney, and Petition, an Assignment and Recordation Form Cover Sheet, Information Disclosure Statement, PTO Form 1449, Cited References, Fee Transmittal, and Check No. _____ for \$1,108.00 are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10 on the date indicated above in an envelope addressed to Box Patent Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

Respectfully submitted,



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UNITED STATES PATENT APPLICATION

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**SYSTEM AND METHOD FOR FILTERING QUERY STATEMENTS FROM
MULTIPLE PLANS AND PACKAGES ACCORDING TO USER-DEFINED
FILTERS OF QUERY EXPLAIN DATA**

U.S. PAT. & TM. OFF.

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1 **SYSTEM AND METHOD FOR FILTERING QUERY STATEMENTS FROM**
2 **MULTIPLE PLANS AND PACKAGES ACCORDING TO USER-DEFINED**
3 **FILTERS OF QUERY EXPLAIN DATA**

4
5 **BACKGROUND OF THE INVENTION**

6
7 1. **Related Applications**

8 This application is a continuation-in-part of U.S. Patent Application Serial
9 No. 08/949,636, filed October 14, 1997, for "Interpreting Data Using a Graphical
10 User Interface," which is incorporated herein by reference.

11
12 2. **Identification of Copyright**

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18
19 3. **The Field of the Invention**

20 The present invention relates generally to computer-implemented database
21 systems. More specifically, the present invention relates to a system and method for
22 filtering query statements from multiple plans and packages according to user-
23 defined filters of query explain data.

1 **4. The Relevant Technology**

2 Databases are computerized information storage and retrieval systems. A
3 Relational Database Management System (RDBMS) is a database system which uses
4 relational techniques for storing and retrieving data. Relational databases are
5 organized into tables consisting of rows (tuples) and columns of data. A database
6 typically includes many tables, and each table includes multiple rows and columns.
7 The tables are conventionally stored in direct access storage devices (DASD), such
8 as magnetic or optical disk drives, for semi-permanent storage.

9 Generally, users communicate with an RDBMS using a Structured Query
10 Language (SQL) interface. The SQL interface allows users to create, manipulate,
11 and query a database by formulating relational operations on the tables, either
12 interactively, in batch files, or embedded in host languages such as C and COBOL.
13 SQL has evolved into a standard language for RDBMS software and has been
14 adopted as such by both the American National Standards Institute (ANSI) and the
15 International Standards Organization (ISO).

16 The SQL standard provides that each RDBMS should respond to a particular
17 query in the same way, regardless of the underlying database. However, the
18 method that the RDBMS actually uses to find the requested information in the
19 database is left to the RDBMS. Typically, there is more than one method that can
20 be used by the RDBMS to access the requested data. The RDBMS, therefore,
21 attempts to select the method that minimizes the computer time and resources (i.e.
22 cost) for executing the query.

23 The RDBMS determines how to execute the SQL statements. The set of steps
24 created by the RDBMS for executing the SQL statements is commonly referred to
25 as the "access path." In other words, the access path is a sequence of operations
26 used by the RDBMS to obtain the data requested by the SQL query. Depending on

1 the access path, an SQL statement might search an entire table space, or,
2 alternatively, it might use an index. The access path is the key to determining how
3 well an SQL statement performs. The description of the access path is stored in a
4 plan table, which typically stores the access path data for a plurality of SQL
5 statements.

6 In addition to determining the access path, some databases estimate the cost
7 for executing each SQL statement. The estimated costs are typically stored in a
8 statement table (as in the case of DB2® for OS/390®) or a similar table within the
9 database. Like the plan table, the statement table stores the estimated statement
10 costs for a plurality of SQL statements.

11 Databases also typically include statistics for such database objects as table
12 spaces, indexes, tables, and columns. For example, in the case of a table, the
13 statistical data may include the number of pages that contain rows of the table, the
14 number of rows and columns in the table, as well as various other statistical data.
15 The statistics are typically derived from the RDBMS "catalog," which is an object
16 that describes the entire database.

17 The above-described access path data, statement cost data, and object
18 statistics data (referred to collectively as "query explain data") assist the user in
19 analyzing and improving the performance of SQL statements. For example, a query
20 with a higher-than-average statement cost might alert the user to inefficiencies in
21 the access path. By viewing the access path data, the user can selectively make
22 changes to the query and/or the database, such as by adding an index in order to
23 avoid a table space scan. The object statistics data similarly assists the user by
24 describing the structure and organization of the database.

25 Unfortunately, analyzing SQL query performance is currently too time-
26 consuming and complex for the average user. Typical systems include hundreds

1 or thousands of query statements. Identifying the one or more statements that need
2 to be improved can be a difficult task. In conventional systems, the user must
3 manually locate the relevant query explain data in a plurality of tables, e.g. the plan
4 table, the statement table, the function table, and the catalog tables, which can be
5 tedious and time-consuming.

6 Moreover, each of the tables typically stores information corresponding to
7 many different statements and objects. Consequently, the tables are often very
8 large, making it difficult to locate the desired data. Likewise, the tables are often
9 cryptic and hard to understand, even for database experts. For example, the plan
10 table typically includes sixty or more columns and hundreds or thousands of rows.
11 The access path data is stored in a tabular format, which, although easily
12 understood by the RDBMS, is often too complicated to be effectively analyzed.

13 Furthermore, the query statements to be filtered are typically included in a
14 number of packages and plans. A package is a collection of query statements found
15 in a single application program. A plan is also a collection of query statements, but
16 may include statements from one or more application programs. In large-scale
17 database systems, the number of plans and packages is correspondingly large.
18 Thus, a difficulty arises when trying to locate a particular package or plan for
19 purposes of analyzing the query statements contained therein.

20 Accordingly, what is needed is a system, method, and article of manufacture
21 for selectively filtering, reducing, or otherwise focusing a list of query statements
22 based on a user's customized data requirements for improving SQL performance.
23 Additionally, what is needed is a system, method, and article of manufacture for
24 filtering query statements according to user-defined filters of query explain data.
25 What is also needed is a system, method, and article of manufacture for generating
26 user-defined filters of object reference data, statement cost data, and access path

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data. Moreover, what is needed is a system, method, and article of manufacture for storing and retrieving sets of user-defined filters. In addition, what is needed is a system, method, and article of manufacture for selectively filtering, reducing, or otherwise focusing a list of packages or plans according to user-defined filtering criteria.

SUMMARY OF THE INVENTION

The present invention solves the foregoing problems by providing a system and method for filtering query statements from multiple plans and packages according to query explain data associated therewith. Additionally, the present invention provides a system and method for filtering a plurality of groups of query statements, such as one or more plans and packages, by applying user-specified filtering criteria to associated identification data.

In one aspect of the invention, an apparatus for filtering a plurality of groups of query statements according to identification data associated therewith includes a processor for executing instructions and a memory device having thereon modules of operational data and executable code for execution by the processor. In one embodiment, the modules include at least one filtering module configured to receive one or more user-specified filtering criteria directed to a subset of the identification data and apply the filtering criteria to selectively exclude those of the plurality of groups not satisfying the filtering criteria. In one embodiment, the modules also include a group listing module configured to display to a user those of the plurality of groups not excluded by the at least one filtering module.

In another aspect of the invention, a method for filtering a plurality of groups of query statements according to identification data associated therewith includes the step of receiving one or more user-specified filtering criteria directed to a subset of the identification data. In one embodiment, the method also includes the step of applying the filtering criteria to selectively exclude those of the plurality of groups not satisfying the filtering criteria. Additionally, the method includes in one embodiment the step of displaying to a user those of the plurality of groups not excluded by the filtering criteria.

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In yet another aspect of the invention, an article of manufacture comprises a program storage medium readable by a processor and embodying one or more instructions executable by the processor to perform the above-described method for filtering a plurality of groups of query statements according to associated identification data.

These and other objects, features, and advantages of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other more detailed and specific objects and features of the present invention are more fully disclosed in the following specification, reference being had to the accompanying drawings, in which

Figure 1 is a schematic block diagram of a computer system suitable for implementing one embodiment of the invention;

Figure 2 is a schematic block diagram of a system for filtering query statements according to user-defined filters of query explain data according to one embodiment of the invention;

Figure 3 is a schematic block diagram of a query visualization module according to one embodiment of the invention;

Figure 4 is an illustration of a query statement and a portion of a plan table according to one embodiment of the invention;

Figure 5 is an illustration of a graphical representation of an access path according to one embodiment of the invention;

Figure 6 is a schematic block diagram of a filter module according to one embodiment of the invention;

Figure 7 is an illustration of the data flow within a filter module according to one embodiment of the invention;

Figure 8 is a schematic flow chart of a method for filtering query statements according to user-defined filters of query explain data;

Figure 9 is an illustration of an interactive display provided by a package selection module according to one embodiment of the invention;

Figure 10 is an illustration of an interactive display provided by a plan selection module according to one embodiment of the invention;

1 Figure 11 is an illustration of an unfiltered list of query statements according
2 to one embodiment of the invention;

3 Figure 12 is an illustration of an interactive display provided by an object
4 filter generation module according to one embodiment of the invention;

5 Figure 13 is an illustration of a filtered list of query statements according to
6 one embodiment of the invention;

7 Figure 14 is an illustration of an interactive display provided by a cost filter
8 generation module according to one embodiment of the invention;

9 Figure 15 is an illustration of a filtered list of query statements according to
10 one embodiment of the invention;

11 Figure 16 is an illustration of an interactive display provided by an access
12 path filter generation module according to one embodiment of the invention;

13 Figure 17 is an illustration of an interactive display provided by an access
14 path filter generation module according to one embodiment of the invention;

15 Figure 18 is an illustration of a filtered list of query statements according to
16 one embodiment of the invention.

17 Figure 19 is a schematic block diagram of a statement selection module
18 according to one embodiment of the invention;

19 Figure 20 is a schematic flow chart illustrating a method for filtering groups
20 of query statements according to one embodiment of the invention;

21 Figure 21 is an illustration of an interactive display provided by a package
22 selection module according to one embodiment of the invention;

23 Figure 22 is an illustration of an interactive display provided by a package
24 selection module according to one embodiment of the invention;

25 Figure 23 is an illustration of a filtered list of packages provided by a
26 package listing module according to one embodiment of the invention;

1 Figure 24 is an illustration of an interactive display provided by a package
2 selection module according to one embodiment of the invention;

3 Figure 25 is an illustration of an interactive display provided by a plan
4 selection module according to one embodiment of the invention;

5 Figure 26 is an illustration of an interactive display provided by a plan
6 selection module according to one embodiment of the invention;

7 Figure 27 is an illustration of a filtered list of plans provided by a plan listing
8 module according to one embodiment of the invention; and

9 Figure 28 is an illustration of an interactive display provided by a plan
10 selection module according to one embodiment of the invention.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The presently preferred embodiments of the present invention will be best understood by reference to the drawings, wherein like parts are designated by like numerals throughout. It will be readily understood that the components of the present invention, as generally described and illustrated in the figures herein, may be arranged and designed in a wide variety of different configurations. Thus, the following more detailed description of the embodiments of the apparatus, system, and method of the present invention, as represented in the Figures, is not intended to limit the scope of the invention, as claimed, but is merely representative of presently preferred embodiments of the invention.

The Figures include schematic block diagrams and flow chart diagrams which illustrate in more detail the preferred embodiments of the present invention. The schematic block diagrams illustrate certain embodiments of modules for performing various functions of the present invention. In general, the represented modules include therein executable and operational data for operation within a computer system of Figure 1 in accordance with the present invention.

As used herein, the term executable data, or merely an "executable," is intended to include any type of computer instructions and computer executable code that may be located within a memory device and/or transmitted as electronic signals over a system bus or network. An identified module of executable code may, for instance, comprise one or more physical or logical blocks of computer instructions which may, for instance, be organized as an object, procedure, or function. Nevertheless, the executables of an identified module need not be located together, but may comprise disparate instructions stored in different locations which together comprise the module and achieve the purpose stated for the module. Indeed, an executable may be a single instruction, or many instructions, and may

1 even be distributed over several different code segments, among different
2 programs, and across several memory devices.

3 Similarly, operational data may be identified and illustrated herein within
4 modules, and may be embodied in any suitable form and organized within any
5 suitable type of data structure. The operational data may be collected as a single
6 data set, or may be distributed over different locations including over different
7 storage devices, and may at least partially exist merely as electronic signals on a
8 system bus or network.

9 Figure 1 is a schematic block diagram that illustrates a computer system 10
10 in which executable and operational data, operating in accordance with the present
11 invention, may be hosted on one or more computer stations 12 in a network 14. The
12 network 14 may comprise a wide area network (WAN) or local area network (LAN)
13 and may also comprise an interconnected system of networks, one particular
14 example of which is the Internet and the World Wide Web supported on the
15 Internet.

16 A typical computer station 12 may include a processor or CPU 16. The CPU
17 16 may be operably connected to one or more memory devices 18. The memory
18 devices 18 are depicted as including a non-volatile storage device 20 such as a hard
19 disk drive or CD-ROM drive, a read-only memory (ROM) 22, and a random access
20 volatile memory (RAM) 24. Preferably, the computer station 12 operates under the
21 control of an operating system (OS) 25, such as MVS®, OS/390®, AIX®, OS/2®,
22 WINDOWS NT®, WINDOWS®, UNIX®, and the like.

23 The computer station 12 or system 10 in general may also include one or
24 more input devices 26, such as a mouse or keyboard, for receiving inputs from a
25 user or from another device. Similarly, one or more output devices 28, such as a
26 monitor or printer, may be provided within or be accessible from the computer

1 system 10. A network port such as a network interface card 30 may be provided for
2 connecting to outside devices through the network 14. In the case where the
3 network 14 is remote from the computer station, the network interface card 30 may
4 comprise a modem, and may connect to the network 14 through a local access line
5 such as a telephone line.

6 Within any given station 12, a system bus 32 may operably interconnect the
7 CPU 16, the memory devices 18, the input devices 26, the output devices 28 the
8 network card 30, and one or more additional ports 34. The system bus 32 and a
9 network backbone 36 may be regarded as data carriers. As such, the system bus 32
10 and the network backbone 36 may be embodied in numerous configurations. For
11 instance, wire, fiber optic line, wireless electromagnetic communications by visible
12 light, infrared, and radio frequencies may be implemented as appropriate.

13 In general, the network 14 may comprise a single local area network (LAN),
14 a wide area network (WAN), several adjoining networks, an intranet, or as in the
15 manner depicted, a system of interconnected networks such as the Internet 40. The
16 individual stations 12 communicate with each other over the backbone 36 and/or
17 over the Internet 40 with varying degrees and types of communication capabilities
18 and logic capability. The individual stations 12 may include a mainframe computer
19 on which the modules of the present invention may be hosted.

20 Different communication protocols, e.g., ISO/OSI, IPX, TCP/IP, may be
21 used on the network, but in the case of the Internet, a single, layered
22 communications protocol (TCP/IP) generally enables communications between the
23 differing networks 14 and stations 12. Thus, a communication link may exist, in
24 general, between any of the stations 12.

25 The stations 12 connected on the network 14 may comprise application
26 servers 42, and/or other resources or peripherals 44, such as printers and scanners.

1 Other networks may be in communication with the network 14 through a router 38
2 and/or over the Internet 40.

3 Referring now to Figure 2, a schematic block diagram of one embodiment
4 of the invention includes first and second stations 12A, 12B. The first station 12A
5 is preferably a workstation-class computer, such as an PC workstation, available
6 from IBM Corporation. The second station 12B is preferably an IBM mainframe
7 computer operating under MVS® or OS/390®. In one embodiment, the stations 12A,
8 12B are coupled via a network 14 using a distributed remote data architecture
9 (DRDA). Those skilled in the art, however, will recognize that the invention may
10 be implemented using a variety of computing platforms and/or network
11 architectures.

12 In one embodiment, the first station 12A includes a query visualization
13 module 50, which is a tool that assists a user in visualizing or otherwise
14 understanding query explain data for one or more queries to be executed. As
15 described above, the query explain data includes, in one embodiment, the access
16 path data, the statement cost data, and the object statistics data used in analyzing
17 and improving the performance of SQL statements.

18 The second station 12B preferably stores a database 52, as well as an RDBMS
19 54 for managing the database 52, such as DB2® for OS/390®, available from IBM. As
20 used herein, the term "database" may generically refer to a combination of the
21 RDBMS 54 and the database 52. In one embodiment, the query visualization
22 module 50 and the RDBMS 54 are linked via an interface module 56, such as DB2
23 Connect®, also available from IBM.

24 Referring now to Figure 3, the query visualization module 50 preferably
25 includes a plurality of modules containing executable and operational data suitable
26 for operation within the memory devices 18 of Figure 1. Of course, the memory

1 devices 18 in which the modules of the present invention are located may also be
2 distributed across both local and remote computer stations 12. Likewise, two or
3 more illustrated modules may be integrated into a single module, or the function
4 of a single module could be performed by a group of modules, without departing
5 from the scope of the invention.

6 The principal components of the query visualization module 50 include a
7 report creator 60, a graph generator 62, and a parameter browser 64. The above-
8 described modules are, in one embodiment, intended to help the user to better
9 understand the query explain data, subsystem parameters, and the like, in a variety
10 of ways.

11 For example, the report creator 60 in one embodiment selectively prepares
12 a report of the access path data, statement cost data, and object statistics data in an
13 easily understood, text-based format. The user may be provided with the option of
14 selecting one or more query statements, as well as subsets of the query explain data
15 for the selected query statements to include in the report. The report provides the
16 user with the requested query explain data in a centralized and readily understood
17 format, allowing the user to efficiently analyze and improve SQL query
18 performance. The report creator 60 is more fully described in co-pending U.S.
19 application Serial No. _____, filed _____, using Express Mail Label
20 EL409135377US, for "System and Method for Selectively Preparing Customized
21 Reports of Query Explain Data," which is commonly assigned and is incorporated
22 herein by reference.

23 A second principal component of the query visualization module 50 in one
24 embodiment is the graph generator 62, which prepares a graphical representation
25 of the access path of a query statement. The graph generator 62 is more fully
26 described in co-pending application Serial No. 08/949,636, filed October 14, 1997,

1 for "Interpreting Data Using a Graphical User Interface," which is incorporated
2 herein by reference. Figure 4 illustrates an exemplary SQL query statement,
3 processed by an RDBMS 54 to generate access path data and stored within a plan
4 table 74 according to one embodiment of the present invention.

5 As shown in Figure 5, the graph generator 62 in one embodiment uses the
6 plan table 74 to generate a graphical representation of the access path. Preferably,
7 access path steps of an SQL statement are graphically represented as nodes within
8 a tree-like structure. Tables, indexes, and operations are graphically represented
9 with unique symbols that indicate the item being represented. For example,
10 rectangles represent tables, triangles represent indexes, and octagons represent
11 operations such as table space scans, index scans, joins, etc. The graphical
12 representation shows the relationship between the database objects and the
13 operations. When the user selects a node of the graphical representation, detailed
14 information related to the selected node is displayed on the right side of the display.

15 Referring again to Figure 3, a third principal component of the query
16 visualization module 50 in one embodiment is the parameter browser 64.
17 Preferably, the parameter browser 64 allows a user to selectively view the
18 subsystem parameters, for example, DSNZPARM and DSNHDECP values, used by
19 a subsystem, as well as the install panel names and fields. Access to subsystem
20 parameters is useful in analyzing the performance of query statements. Like the
21 graph generator 62, the parameter browser 64 is more fully described in co-pending
22 application Serial No. 08/949,636, filed October 14, 1997, for "Interpreting Data
23 Using a Graphical User Interface."

24 The report creator 60, graph generator 62, and parameter browser 64 are
25 each preferably coupled to a graphical user interface (GUI) module 66. Preferably,
26 the GUI module 66 is operably coupled to the input and output devices 26, 28 to

allow the user to interact with the report creator 60, graph generator 62, and parameter browser 64.

The query visualization module 50 in the depicted embodiment also includes an explain module 68, which invokes a corresponding explain function 70 in the RDBMS 54. When invoked, the explain function 70 causes the RDBMS 54 to generate function data, access path data, and the statement cost data (referred to herein as “explain data”) for a specified query statement.

Explainable query statements include SELECT (except for SELECT INTO) and INSERT statements, and the searched form of UPDATE and DELETE statements. The explain module 68 is used to invoke an explain function 70 in which the RDBMS 54 immediately generates explain data for a specific SQL statement. This feature is useful for interactively testing specified SQL statements. Alternatively, the RDBMS 54 generates the explain data at bind time in the context of an application or package upon encountering an EXPLAIN(YES) open of the BIND command.

In one embodiment, the query visualization module 50 includes a plurality of querying modules for querying various tables in the database 52. For example, a plan table querying module 72 queries a plan table 74 to obtain access path data. Likewise, a statement table querying module 76 queries a statement table 78 to obtain statement cost data. A function table querying module 80 queries a function table 82 to obtain data concerning user-defined functions. The plan table 74, the statement table 78, and the function table 82 are collectively referred to herein as “explain tables.” Finally, a catalog querying module 86 queries the RDBMS catalog 88 to obtain object statistics for one or more database objects contained within in a plurality of user tables 90.

1 Although the querying function is implemented herein by four separate
2 modules, those skilled in the art will recognize that the described functionality may
3 be implemented by fewer modules. Additionally, in one embodiment, the above-
4 described modules use the interface module 56 when communicating with the
5 RDBMS 54 and database 52.

6 Preferably, the query visualization module 50 also includes a filter module
7 92, which is described in greater detail below. In one embodiment, the filter module
8 92 allows a user to filter a list of explainable query statements according to various
9 user-selected criteria, including statement costs, references to particular database
10 objects, and the inclusion of particular steps in the access paths of the statements.
11 Moreover, in one embodiment, the user may assign a name to a set of filtering
12 criteria and save the named set in a filter storage 94. This allows the user to easily
13 retrieve a specified set of filtering criteria such that only the explainable query
14 statements satisfying the criteria are listed.

15 In one embodiment, the filter module 92 also allows a user to filter a set of
16 plans and packages according to various identification data, such as plan and
17 package names, collection identifiers, version identifiers, and the like. The filter
18 module 92 is described in greater detail below with respect to Figure 6.

19 The query visualization module 50 also preferably includes a cache module
20 96, which caches portions of the above-described tables in a cache storage 98. For
21 example, when the plan table querying module 72 retrieves access path data from
22 the plan table 74, the access path data is preferably stored, and future accesses to the
23 same data will be retrieved from the cache storage 98. Various methods may be
24 employed for managing data in the cache storage 98, such as automatically deleting
25 a percentage of the cached data when the amount of the data exceeds a pre-defined
26 threshold.

1 Referring now to Figure 6, the filter module 92 preferably includes a
2 plurality of modules containing executable and operational data suitable for
3 operation within the memory devices 18 of Figure 1. In one embodiment, the
4 memory devices 18 in which the modules of the present invention are located may
5 also be distributed across both local and remote computer stations 12. Likewise,
6 two or more illustrated modules may be integrated into a single module without
7 departing from the scope of the invention, and additional modules could be utilized
8 to perform the same functions.

9 In one embodiment, the filter module 92 includes a statement selection
10 module 100, which allows a user to select an initial set of query statements to be
11 filtered. Briefly, a package comprises one or more query statements from a common
12 application. Likewise, a plan is an assemblage of query statements, but may
13 correspond to more than one application. The user may preferably select one or
14 more plans or packages to create the initial set of query statements.

15 As described above, the initial set of query statements may be very large,
16 particularly for a company-wide database. Consequently, it may be difficult for a
17 user to locate a particular query statement, when, for example, the user wishes to
18 select the statement for graphing, for SQL text display, for generation of a report
19 containing the statement, or the like.

20 To alleviate this problem, the filter module 92 preferably includes a filter
21 generation module 102. In one embodiment, the filter generation module 102 allows
22 the user to create one or more filters for selectively reducing a list of query
23 statements based on subsets of the query explain data previously generated for the
24 statements by the RDBMS 54. In the depicted embodiments, each filter includes
25 user-specified filtering criteria that are applied to the corresponding subset of the
26

1 query explain data to selectively exclude from the initial set the query statements
2 not satisfying the filtering criteria.

3 The filter generation module 102 preferably includes an object filter
4 generator 104 for assisting a user in generating a user-defined object filter 106. In
5 one embodiment, the object filter 106 includes filtering criteria for selectively
6 excluding query statements from the initial set based on whether the query
7 statements either reference a specified database object (such as a table, index, or the
8 like) or reference an object created by a specified person.

9 Similarly, the filter generation module 102 also includes, in one embodiment,
10 a cost filter generator 108 for assisting a user in generating a user-defined cost filter
11 110. The cost filter 110 preferably includes filtering criteria for selectively excluding
12 query statements from the initial set based on how the statement cost data for each
13 query statement compares with a specified threshold cost.

14 Likewise, the filter generation module 102 preferably includes an access path
15 filter generator 112 for assisting a user in generating a user-defined access path filter
16 114. The access path filter 114 preferably includes filtering criteria for selectively
17 excluding query statements from the initial set based on whether the statements
18 include specified execution steps in their access paths. Other types of filter
19 generators may also be added as needed.

20 To apply the foregoing filters, the filter module 92 preferably includes a
21 statement filtering module 116. In one embodiment, the statement filtering module
22 116 applies the filtering criteria of the filters to subsets of the query explain data for
23 the initial set of query statements.

24 In the depicted embodiment, the statement filtering module 116 includes an
25 object criteria module 118 for applying the filtering criteria of an object filter 106.
26 Preferably, the object criteria module 118 communicates with the plan table

1 querying module 72 to obtain the access path data for each query statement from
2 the plan table 74. From the access path data, the object criteria module 118 may
3 determine whether each statement references a database object specified in the
4 filtering criteria, such as a table, index, or the like.

5 Additionally, the statement filtering module 116 preferably includes a cost
6 criteria module 120 for applying the filtering criteria of a cost filter 110. In one
7 embodiment, the cost criteria module 120 communicates with the statement table
8 querying module 76 to obtain the statement cost data for each query statement from
9 the statement table 78. From the statement cost data, the cost criteria module 120
10 may determine whether each statement satisfies the filtering criteria of the cost filter
11 110.

12 In one embodiment, the statement filtering module 116 also includes an
13 access path criteria module 122 for applying the filtering criteria of an access path
14 filter 114. Preferably, the access path criteria module 122 communicates with the
15 plan table querying module 72 to obtain the access path data for each query
16 statement from the plan table 74. From the access path data, the access path criteria
17 module 122 may determine whether the access path of each statement includes
18 execution steps specified in the filtering criteria of the access path filter 114.

19 In one embodiment, the filter module 92 also includes a statement listing
20 module 124. The statement listing module 124 preferably displays the filtered set
21 of query statements to the user, additionally allowing the user to select one or more
22 of the query statements for purposes of modifying the statements, including the
23 statements in a report, explaining the query statements, or the like.

24 In one embodiment, the filter module 92 also includes a filter storage
25 module 126. After the user has generated one or more filters, the filter storage
26 module 126 preferably allows the user to store the filters as a set 130 in the filter

1 storage 94. In one embodiment, the user may assign a name to a set 130 of filters in
2 the filter storage 94. Later, the user may retrieve and use the stored filters without
3 having to recreate them, as described in greater detail below.

4 Figure 7 is an illustration of the data flow within the filter module 92
5 according to one embodiment of the invention. As described above, the RDBMS 54
6 generates query explain data for a plurality of query statements. Using the
7 statement selection module 100, the user may select one or more plans and/or
8 packages, which define an initial set of query statements to be filtered.

9 A user may, using the filter generation module 102, generate one or more
10 filters, such as an object filter 106, a cost filter 110, and an access path filter 114.
11 Optionally, the filters may be stored in the filter storage 94 by means of the filter
12 storage module 126. Later, a user may retrieve the filters from the filter storage 94.
13 In one embodiment, the filters may include the user's selection of the plans and/or
14 packages.

15 In one embodiment, the statement filtering module 116 accepts as input the
16 initial set of query statements, the query explain data for the statements, and one or
17 more user-defined filters, either generated by the filter generation module 102 or
18 retrieved from the filter storage 94. Using the techniques described above, the
19 statement filtering module 116 applies the filtering criteria of each user-defined filter
20 to selectively exclude from the initial set the query statements not satisfying the
21 filtering criteria. Preferably, the statement filtering module 116 provides the filtered
22 query statements to the statement listing module 124, which displays a list of the
23 filtered query statements to the user.

24 Referring now to Figure 8, a schematic flow chart illustrates a method of
25 filtering query statements according to one embodiment of the invention. The
26 method begins by determining 132 whether to create new filters or to retrieve a set

1 130 of stored filters. In the depicted embodiment, a user may create new filters by
2 selecting a "new" button 146 or a similar control. Alternatively, a user may retrieve
3 a set 130 of filters from the filter storage 94 by selecting the name of a set 130 from
4 a pull-down menu 148 (of Figure 10), which lists the names of the filter sets 130
5 stored in the filter storage 94.

6 If, in step 132 of Figure 8, the user elects to create new filters, the method
7 continues by receiving 134 a user's selection of one or more plans and/or packages.
8 As noted above, a package corresponds to one or more query statements in a
9 common application. Likewise, a plan is an assemblage of query statements, but
10 may correspond to more than one application.

11 Figures 9 and 10 are illustrations of interactive displays, generated by the
12 statement selection module 100 for receiving a user's selection of one or more plans
13 and/or packages. Figure 9 illustrates an interactive display for selecting packages
14 according to one embodiment of the invention. Preferably, the statement selection
15 module 100 provides an "add" button 134, or a similar control, through which the
16 user may select to add one or more packages to a selected package list 136. In one
17 embodiment, the user may add packages by name or by performing a search of the
18 packages based on such criteria as package owner, package name, collection ID, and
19 version. This process is described in greater detail below with respect to Figures 19-
20 28.

21 In one embodiment, the selection module 100 employs a control such as a
22 "change" button 138 for changing one or more of the selected packages in the
23 selected package list 136. In addition, the selection module 100 may include a
24 "remove" button 140 or similar control for removing one or more of the selected
25 packages.

26 Figure 10 illustrates an interactive display for selecting plans according to

1 one embodiment of the invention. Preferably, the selection module 100 provides a
2 control such as an "add" button 134 for adding one or more plans to a selected plan
3 list 142. As noted above, a plan is similar to a package but may include query
4 statements for more than one application.

5 After the user's selection of plans and/or packages is received, the method
6 continues by receiving 150 user-specified filtering criteria, if any, for an object filter
7 106. It should be recognized that a user is not required in one embodiment to create
8 a complete set of filters or, indeed, any filters. Thus, if the user selects an "OK"
9 button 152 (of Figure 10) or the like without creating any filters, the statement listing
10 module 124 (of Figure 7) preferably lists all of the query statements in the selected
11 plans and/or packages. Figure 11 illustrates an unfiltered listing of the plurality of
12 query statements for the selected plans of Figure 10. If the user does not define an
13 object filter 106, the method simply proceeds with step 168.

14 Figure 12 is an illustration of an interactive display provided by the object
15 filter generator 104 for receiving user-specified filtering criteria of an object filter
16 106. In the depicted embodiment, the interactive display for the object filter
17 generator 104 is shared with the cost filter generator 108. However, in alternative
18 embodiments, separate interactive displays are provided. Preferably, the interactive
19 display for the cost filter generator 108 is selectively displayed by means of a
20 suitable control such as a "Cost / object filters" tab 153.

21 In one embodiment, the interactive display includes a set of customizable
22 relational expressions 154 for specifying filtering criteria of an object filter 106. Each
23 relational expression preferably represents an individual filtering criterion that is
24 applied to the object reference data for each query statement. Although the
25 following description illustrates a preferred user interface, a variety of other user
26 interfaces may be employed within the scope of the invention.

1 In the depicted embodiment, each relational expression 154 includes three
2 fields: a name field 156, an operator field 158, and a value field 160. The name field
3 156 preferably represents a type of database object referenced by a query statement,
4 such as a table or an index. In addition, the name field 156 may represent an object
5 creator, i.e. a person who created one or more referenced objects.

6 The operator field 158 is preferably selectable from a number of relational
7 operators, such as "equal to," "not equal to," "greater than," "less than," "in" or
8 "like." In one embodiment, the operator field 158 may be selected using a pull
9 down menu or similar mechanism.

10 Preferably, the value field 160 stores the name of a specific object or a name
11 of a specific object creator. In one embodiment, the value field 160 is specified using
12 a text entry field or like mechanism.

13 For example, as shown in Figure 12, the expression 154A includes "Table
14 names" in the name field 156, "=" in the operator field 158, and "TBDB0101" in the
15 value field 160. Thus, in one embodiment, the resulting relational expression,
16 "Table names = TBDB0101," specifies that only the query statements referencing the
17 "TBDB0101" table will pass through the object filter 106; all other statements will be
18 excluded. For example, as displayed by the statement listing module 124 in Figure
19 13, each of the filtered statements references the "TBDB0101" table.

20 In one embodiment, a filter may include a plurality of relational expressions
21 combined with boolean operators. In the illustrated embodiment of Figure 12, the
22 relational expressions 154 may be combined using a logical (inclusive) "OR" by
23 selecting the "Meet any filter condition" option 162. Alternatively, the relational
24 expressions 154 may be combined using a logical "AND" by selecting the "Meet all
25 filter conditions" option 164. Other boolean operations may also be provided, such
26 as NOT, exclusive-OR, and the like.

1 Referring again to Figure 8, after the filtering criteria for the object filter 106
2 is received, the method continues by receiving 168 filtering criteria, if any, for a cost
3 filter 110. Figure 14 is an illustration of an interactive display provided by the cost
4 filter generator 108 for receiving user-specified filtering criteria of a cost filter 110.
5 Preferably, the interactive display for the cost filter generator 108 may be selectively
6 displayed by means of the "Cost / object filters" tab 153.

7 In one embodiment, the interactive display includes a set of customizable
8 relational expressions 170 for specifying the filtering criteria for a cost filter 110.
9 Each relational expression 170 preferably represents an individual filtering criterion
10 that is applied to the statement cost data for each query statement.

11 The relational expressions 170 for the cost filter 110 are similar in form to
12 those of the object filter 106. However, the name field 156 preferably represents cost
13 units for measuring the cost of executing the query statement. In one embodiment,
14 the cost units are either milliseconds or service units. Service units are a measure
15 of a computer's processing resources needed to execute the query statement. The
16 value field 160 preferably stores a threshold cost to be compared with the statement
17 cost of each query statement.

18 For example, as shown in Figure 14, the expression 170A includes "Cost in
19 milliseconds" in the name field 156, ">" in the operator field 158, and "1000" in the
20 value field 160. Thus, the relational expression, "Cost in milliseconds > 1000"
21 specifies that only those query statements with an estimated cost greater than 1000
22 milliseconds will pass through the cost filter 110; all other statements will be
23 excluded. For example, as displayed by the statement listing module 124 in Figure
24 15, each of the filtered statements has a cost greater than 1000 milliseconds.

25 Referring again to Figure 8, after the filtering criteria for the cost filter 110
26 is received, the method continues by receiving 172 filtering criteria, if any, for an

1 access path filter 114. Figure 16 is an illustration of an interactive display provided
2 by the access path filter generator 112 for receiving user-specified filtering criteria
3 of an access path filter 114. Preferably, the interactive display for the access path
4 filter generator 112 is selectively displayed by means of an "Access path filters" tab
5 174.

6 In one embodiment, the access path filter generator 112 displays a plurality
7 of customizable boolean expressions 176. Preferably, each of the boolean
8 expressions 176 represents access path steps. For example, as depicted in Figure 16,
9 the access path steps may include sorts, table space scans, and the like.

10 In one embodiment, each of the boolean expressions 176 include a name
11 field 156 and a value field 160. The name field 156 preferably includes a type of
12 access path step. The value field 160 is preferably a truth value, i.e. true or false. In
13 one embodiment, the value field 160 is selectively changeable by clicking on the
14 associated field with a mouse or other pointing device.

15 Query statements are preferably allowed to pass through the access path
16 filter 114 if the statements include any of the access path steps having a value field
17 160 of true. In one embodiment, the individual boolean expressions 176 are
18 combined using a logical OR. In alternative embodiments, the expressions 176 may
19 be combined using other boolean operators, such as AND.

20 In one embodiment, the access path filter generator 112 provides a "Set to
21 all true" button 177 for conveniently setting all of the value fields 160 to true.
22 Likewise, the access path filter generator 112 provides a "Set to all false" button 178
23 for setting all of the value fields 160 to false.

24 As illustrated in Figure 17, a user may desire to see a list of query statements
25 including sorts in the statements' access paths. This may be accomplished in one
26 embodiment by setting all of the value fields 160 to false using the "Set all to false"

1 button 178 and changing the "Sorts" value field 160 to true. Accordingly, when the
2 access path filter 114 is applied, only the statements having sorts are displayed. For
3 example, as displayed by the statement listing module 124 in Figure 18, all of the
4 listed query statements include sorts in the statements' access paths.

5 After the filtering criteria for the access path filter 114 is received, the
6 method continues by creating 180 the filters corresponding to the user-defined
7 filtering criteria. In one embodiment, the filters are data structures including
8 representations of the relational expressions 154, 170 and boolean expressions 176.
9 In addition, each filter may include, in one embodiment, the selection of plans
10 and/or packages made by the user in step 144. The type of data structure is not
11 crucial to the invention. However, it is preferred that the statement filtering module
12 116 is capable of interpreting the data structures to obtain the relational expressions
13 154, 170 and boolean expressions 176, for the filtering criteria, as well as the
14 plan/package selection.

15 After the filters are created, the method continues by determining 182
16 whether to save the user-specified filter(s) as a set 130 in the filter storage 94. The
17 user may elect (or may have previously elected) to give a name to a set 130 of filters
18 and store the set 130 by means of the "Save" or "Save as" buttons 184, 186.

19 If the user selects one of the foregoing buttons 184, 186, the method
20 continues with step 188 by receiving the name of the filter set 130 (if not previously
21 provided) and storing the filter set 130 in the filter storage 94 using the specified
22 name; otherwise, the method continues with step 192.

23 As previously noted in step 144, a user may elect to retrieve a stored filter
24 set 130, rather than creating new filters by means of the filter generation module
25 102. This is accomplished, in one embodiment, by selecting a set 130 from a pull
26 down menu 148, which lists the names of the filter sets 130 stored in the filter

1 storage 94. Thus, if the user elects to retrieve a stored set in step 144, the method
2 continues by receiving 190 a name of a user-specified filter set 130 and retrieving the
3 set 130 from the filter storage 94.

4 In one embodiment, the user may elect to modify the retrieved filter 190
5 using the techniques described in steps 150, 168, and 172. As noted above, the
6 filters may include, in one embodiment, the selection of plans and/or packages
7 made by the user in step 144. However, in an alternative embodiment, the user may
8 proceed to specify a new or different set of plans and/or packages as described in
9 step 132.

10 After the completion of either steps 182, 188, or step 190, one or more filters
11 will have been generated and/or retrieved. Preferably, the user requests a list of
12 filtered statements by selecting the "OK" button 152. Thereafter, the method
13 continues by applying 192 the object filter 106, if any, to the query statements. After
14 the object filter 106 is applied, the method continues by applying 194 the cost and
15 access path filters 110, 114 if any were defined.

16 When the filtering process is complete, the statement listing module 124
17 displays a list of the filtered query statements to the user. As shown in Figure 13,
18 the statement listing may include such information as a statement number, a
19 package name, a cost in milliseconds, a cost in service units, the SQL text of the
20 query statement, a collection ID, a plan name, and an owner name.

21 Additionally, in one embodiment, the statement listing module 124 allows
22 the user to select a filtered statement for graphing, for SQL text display, for
23 generation of a report containing the statement, or the like. Figures 13, 15, and 18
24 illustrate an interactive display generated by the statement listing module 124 for
25 listing the filtered query statements according to one embodiment of the invention.
26

1 Referring now to Figure 19, the statement selection module 100 preferably
2 includes a plurality of modules containing executable and operational data suitable
3 for operation within the memory devices 18 of Figure 1. Of course, the memory
4 devices 18 in which the modules of the present invention are located may also be
5 distributed across both local and remote computer stations 12. Likewise, two or
6 more illustrated modules may be integrated into a single module, or the
7 functionality of a single module may be implemented using a plurality of modules,
8 without departing from the scope of the invention.

9 In one embodiment, the statement selection module 100 includes a package
10 selection module 200 and a plan selection module 202 for assisting a user in
11 selecting one or more packages and plans, respectively. As previously explained,
12 packages and plans correspond to groups of query statements associated with
13 application programs that query the database 52. Thus, by selectively designating
14 one or more packages and plans, the user may define the initial set of query
15 statements to be received as input to the statement filtering module 116 of Figure
16 6.

17 In typical large-scale database systems, the number of packages and plans
18 is correspondingly large, and finding a particular package or plan can be difficult.
19 Accordingly, both the package selection module 200 and the plan selection module
20 202 preferably include a number of filtering modules for selectively filtering an
21 initial set of packages and plans according to user-specified filtering criteria.

22 In one embodiment, the filtering criteria for each filtering module is directed
23 to identification data stored in the catalog 88 for each package and plan. Thus, in
24 one embodiment, the catalog querying module 86 is used to access the
25 plan/package identification data.
26

1 For example, in one embodiment, the package selection module 200 includes
2 a package owner filtering module 208 for filtering a set of packages according to
3 package owner data for each package. Preferably, each package identifies an
4 owner, i.e. a user ID of the creator or creators of the package. In one embodiment,
5 the package owner filtering module 208 receives from a user an identification of one
6 or more owners and filters the packages according to whether the packages were
7 created by the specified owners.

8 Additionally, the package selection module 200 includes, in one
9 embodiment, a package name filtering module 210 for filtering a set of packages
10 according to package name data for each package. Preferably, each package has a
11 unique name for identifying the package. In one embodiment, the package name
12 filtering module 210 receives from a user the names of one or more packages and
13 filters the packages according to whether the packages have the specified names.

14 In one embodiment, the package selection module 200 also includes a
15 collection ID filtering module 212 for filtering a set of packages according to
16 collection ID's. A collection ID is an identification of a group of packages. In one
17 embodiment, the collection ID filtering module 212 receives from a user the ID's of
18 one or more collections, and filters the packages according to whether the packages
19 are members of the specified collections.

20 Additionally, in one embodiment, the package selection module 200
21 includes a version filtering module 214 for filtering packages according to version
22 data. In one embodiment, each package has a version identifier for identifying the
23 version of the package. Preferably, the version filtering module 214 receives from
24 a user the identifiers of one or more versions and filters the packages according to
25 whether the packages include the specified version identifiers.
26

1 Preferably, the package selection module 200 also includes a package listing
2 module 216 for displaying to a user a selectable list of the filtered packages. In one
3 embodiment, the user may select one or more of the packages in order to select the
4 initial set of query statements.

5 In one embodiment, the plan selection module 202 includes a similar set of
6 filtering modules. For example, the plan selection module 202 includes a plan
7 owner filtering module 218 for filtering plans according to plan owner data for each
8 plan. Preferably, each plan identifies an owner, i.e. the user ID of the creator or
9 creators of the plan. In one embodiment, the filtering module 218 receives from a
10 user an identification of one or more owners and filters the plans according to
11 whether the plans were created by the specified owners.

12 Additionally, the plan selection module 202 includes, in one embodiment,
13 a plan name filtering module 220 for filtering plans according to plan name data for
14 each plan. Preferably, each plan has a unique name for identifying the plan. In one
15 embodiment, the plan name filtering module 220 receives from a user one or more
16 names of plans and filters the plans according to whether the plans have the
17 specified names.

18 Preferably, the plan selection module 202 also includes a database request
19 module (DBRM) name filtering module 222 for filtering plans according to DBRM
20 name data associated with each plan. In one embodiment, the DBRM name filtering
21 module 222 receives from a user one or more DBRM names and filters the plans
22 according to the specified DBRM names.

23 Preferably, the plan selection module 202 also includes a plan listing module
24 224 for displaying to a user a selectable list of the filtered plans. In one embodiment,
25 the user may select one or more of the plans in order to select the initial set of query
26 statements.

1 Referring now to Figure 20, a schematic flow chart illustrates a method for
2 filtering a set of plans and packages according to one embodiment of the invention.
3 The method begins by receiving 230 user-specified package filtering criteria for
4 filtering an initial set of packages.

5 Figure 21 illustrates an interactive display generated by the statement
6 selection module 100, and more particularly, by the package selection module 200,
7 according to one embodiment of the invention. As previously described, the
8 statement selection module 100 preferably generates an "add" button 134 or other
9 suitable control, which the user may select to add one or more packages to the
10 selected package list 136.

11 As illustrated in Figure 22, when the "add" button 134 is selected, a set of
12 customizable package filtering criteria is preferably displayed. In one embodiment,
13 the package filtering criteria include a number of relational expressions 250.
14 Preferably, a relational expression 250 is provided for each filtering module,
15 including the package owner filtering module 208, the package name filtering
16 module 210, the collection ID filtering module 212, and the version filtering module
17 214.

18 For example, in the depicted embodiment, the package owner filtering
19 module 208 corresponds to the relational expression 250A. Preferably, the
20 expression 250A has the form:

21 "Package owner:" OPERATOR VALUE

22 where the OPERATOR field is selectable from a number of relational operators,
23 such as "equal to," "not equal to," "greater than," "less than," "in," or "like," and
24 the VALUE field stores the identifiers of one or more package owners. In one
25 embodiment, the OPERATOR field may be selected using a pull down menu or the
26

1 like, while the VALUE field may be supplied using a text entry box or other suitable
2 mechanism.

3 The completed expression 250A, i.e. "Package owner: IN ADMF001,
4 USER001, SYSADM," is preferably interpreted by the package owner filtering
5 module 208 as an instruction to provide to the package listing module 216 only
6 those packages owned by "ADMF001," "USER001," and "SYSADM."

7 The user may similarly select filters corresponding to package names
8 (expression 250B), collection identifiers (expression 250C), and versions (expression
9 250D). In one embodiment, the package name filtering module 210 corresponds to
10 the relational expression 250B, which has a similar format to expression 250A.
11 Likewise, the collection ID filtering module 212 corresponds to the relational
12 expression 250C, and the version filtering module 214 corresponds to the relational
13 expression 250D.

14 Referring to Figure 20, after the package filtering criteria are received, the
15 method continues by applying 232 the package filtering criteria to an initial set of
16 packages. In one embodiment, the initial set may include all of the packages
17 querying the database 52 or any user-defined subset of the packages. In one
18 embodiment, the user may initiate the filtering process by selecting an "OK" button
19 152 (of Figure 22) or the like, which will cause the filtering modules having defined
20 relational expressions 250 to apply the filtering criteria to the initial set of packages.

21 Thereafter, the method continues by displaying 234 a filtered list of packages
22 to the user. Figure 23 illustrates the filtered list of selectable packages generated in
23 response to the expression 250A of Figure 22. As provided in the filtering criteria,
24 each of the listed packages is owned by "ADMF001," "USER001," or "SYSADM."

25 After the filtered list is displayed, the method continues by receiving 236 a
26 user's selection of one or more of the packages. In one embodiment, the user may

1 select the desired packages by highlighting individual packages with a mouse or
2 other pointing device. After the one or more packages are highlighted, the user may
3 confirm his or her selections by means of an "add" button 254 or other suitable
4 control, which will preferably cause the selected packages (of Figure 23) to be added
5 to the selected package list 136, as shown in Figure 4. These selected packages are
6 then used to define the initial set of query statements as previously described.

7 The process of selecting plans is substantially similar to the above-described
8 process of selecting packages. In step 238, the method continues by receiving 238
9 user-specified plan filtering criteria to be used in filtering an initial set of plans.
10 Figure 25 illustrates an interactive display generated by the statement selection
11 module 100 of Figure 19, and more particularly, by the plan selection module 202,
12 before any plans have been selected. As previously described, the statement
13 selection module 100 provides in one embodiment an "add" button 134, which the
14 user may select to add one or more plans to the selected plan list 142.

15 As illustrated in Figure 26, when the "add" button 134 (of Figure 25) is
16 selected, a set of customizable plan filtering criteria is preferably displayed. In one
17 embodiment, the plan filtering criteria includes a number of relational expressions
18 260 that are applied the list of plans in the database 52. Preferably, a relational
19 expression 260 is provided for each filtering module, including the plan owner
20 filtering module 218, the plan name filtering module 220, and the DBRM name
21 filtering module 222.

22 For example, in the depicted embodiment, the plan owner filtering module
23 218 corresponds to the relational expression 260A. Preferably, the expression 260A
24 has the form:

25 "Plan owner:" OPERATOR VALUE
26

where the OPERATOR field is selectable from a number of relational operators, such as "equal to," "not equal to," "greater than," "less than," "in," or "like," and the VALUE field stores the identifiers of one or more plan owners. In one embodiment, the OPERATOR field may be selected using a pull down menu or the like, while the VALUE field may be supplied using a text entry box or other suitable mechanism.

The completed expression 260A, i.e. "Plan owner: = ADMF001," is preferably interpreted by the plan owner filtering module 218 as an instruction to provide to the plan listing module 224 only those plans owned by "ADMF001."

Similarly, a user may further refine the selected list of plans by selecting filters corresponding to plan names (expression 260B) and DBRM names (expression 260C). In the depicted embodiment, the plan name filtering module 220 corresponds to the relational expression 260B and operates in substantially the same way as the plan owner filtering module 218. In other words, the OPERATOR field is selectable as described above, and the VALUE field stores the names of one or more plans. Likewise, the DBRM name filtering module 222 corresponds to the relational expression 260C.

For example, the completed expression 260C, i.e. "DBRM name: LIKE PROG%," is interpreted by the DBRM name filtering module 222 as an instruction to provide to the plan listing module 224 only those plans having a DBRM name such as PROG1, PROG2, PROG3, etc. The LIKE operator permits wildcards, such as "%," which can be used to represent any number of alphanumeric characters.

After the plan filtering criteria are received, the method of Figure 20 continues by applying 240 the plan filtering criteria to an initial set of plans as described above. In one embodiment, the initial set may include all of the plans that query the database 52 or any user-defined subset of the plans. In one embodiment,

1 the user may signal the filtering modules to apply the filtering criteria by selecting
2 an "OK" button 252 (of Figure 26) or similar control.

3 Once the filtering criteria of the filtering modules are applied, the method
4 continues by displaying 242 a filtered list of plans to the user. Figure 27 illustrates
5 a filtered list of selectable plans generated in response to the expressions 260A and
6 260C of Figure 26. As provided in the filtering criteria, each of the listed plans is
7 owned by "ADMF001" and has a DBRM name of the form "PROG%."

8 After the filtered list is displayed, the method continues by receiving 244 a
9 user's selection of one or more of the plans. In one embodiment, the user may
10 select the plans by highlighting individual plans with a mouse or other pointing
11 device. After the one or more plans are highlighted, the user may confirm his or her
12 selections by means of an "add" button 262 or other suitable control, which causes
13 the selected plans to be added to the selected plan list 142 as shown in Figure 28.

14 The present invention may be embodied in other specific forms without
15 departing from its scope or essential characteristics. The described embodiments
16 are to be considered in all respects only as illustrative and not restrictive. The scope
17 of the invention is, therefore, indicated by the appended claims rather than by the
18 foregoing description. All changes which come within the meaning and range of
19 equivalency of the claims are to be embraced within their scope.

20 What is claimed and desired to be secured by United States Letters Patent
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Claims

1. An apparatus for filtering a plurality of groups of query statements according to identification data associated therewith, each group corresponding to one or more application programs posing queries to a database, the apparatus comprising:

a memory device having thereon modules of code for execution by a processor, the modules comprising:

at least one filtering module configured to receive one or more user-specified filtering criteria directed to a subset of the identification data and apply the filtering criteria to selectively exclude those of the plurality of groups not satisfying the filtering criteria.

2. The apparatus of claim 1, further comprising:

a group listing module configured to display to a user those of the plurality of groups not excluded by the at least one filtering module.

3. The apparatus of claim 1, further comprising:

a group selection module configured to receive a user selection of one or more of the groups displayed by the group listing module for selectively filtering the query statements associated with the selected groups according to user-defined filters of query explain data.

1 4. The apparatus of claim 1, wherein the identification data comprises
2 data selected from the group consisting of owner data, name data, collection ID
3 data, and version data.

4
5 5. The apparatus of claim 1, wherein at least one group comprises a
6 package, each package corresponding to one application program posing queries
7 to the database.

8
9 6. The apparatus of claim 5, wherein the identification data comprises an
10 owner of each package, the at least one filtering module comprising:

11 a package owner filtering module configured to filter a plurality of
12 packages according to at least one package owner specified in the
13 filtering criteria.

14
15 7. The apparatus of claim 5, wherein the identification data comprises a
16 name of each package, the at least one filtering module comprising:

17 a package name filtering module configured to filter a plurality of packages
18 according to at least one package name specified in the filtering
19 criteria.

20
21 8. The apparatus of claim 5, wherein the identification data includes a
22 collection ID to which at least one package belongs, the at least one filtering module
23 comprising:

24 a collection ID filtering module configured to filter a plurality of packages
25 according to at least one collection ID specified in the filtering criteria.
26

1 9. The apparatus of claim 5, wherein the package identification data
2 includes a version of each package, the at least one filtering module comprising:

3 a version filtering module configured to filter a plurality of packages
4 according to at least one package version specified in the filtering
5 criteria.

6
7 10. The apparatus of claim 1, wherein at least one group comprises a plan,
8 each plan corresponding to one or more application programs posing queries to the
9 database.

10
11 11. The apparatus of claim 10, wherein the identification data includes an
12 owner of each plan, the at least one filtering module comprising:

13 a plan owner filtering module configured to filter a plurality of plans
14 according to at least one plan owner specified in the filtering criteria.

15
16 12. The apparatus of claim 10, wherein the identification data includes a
17 name of each plan, the at least one filtering module comprising:

18 a plan name filtering module configured to filter a plurality of plans
19 according to at least one plan name specified in the filtering criteria.

20
21 13. The apparatus of claim 10, wherein the identification data includes a
22 database request module (DBRM) name for each plan, the at least one filtering
23 module comprising:

24 a DBRM name filtering module configured to filter a plurality of plans
25 according to at least one DBRM name specified in the filtering criteria.
26

1 14. A method for filtering a plurality of groups of query statements
2 according to identification data associated therewith, each group corresponding to
3 one or more application programs posing queries to a database, the method
4 comprising:

5 receiving one or more user-specified filtering criteria directed to a subset of
6 the identification data; and

7 applying the filtering criteria to selectively exclude those of the plurality of
8 groups not satisfying the filtering criteria.

9
10 15. The method of claim 14, further comprising:

11 receiving a user selection of one or more of the groups not excluded by the
12 filtering criteria for selectively filtering the query statements
13 associated with the selected groups according to user-defined filters
14 of query explain data.

15
16 16. The method of claim 14, wherein the identification data comprises
17 data selected from the group consisting of owner data, name data, collection ID
18 data, and version data.

19
20 17. The method of claim 14, further comprising:

21 obtaining the identification data for at least one group from a database
22 catalog.

23
24 18. The method of claim 14, wherein at least one group comprises a
25 package, each package corresponding to one application program posing queries
26 to the database.

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19. The method of claim 18, wherein the identification data comprises an owner of each package, the filtering step comprising:
filtering a plurality of packages according to at least one package owner specified in the filtering criteria.

20. The method of claim 18, wherein the identification data comprises a name of each package, the filtering step comprising:
filtering a plurality of packages according to at least one package name specified in the filtering criteria.

21. The method of claim 18, wherein the identification data includes a collection ID to which at least one package belongs, the filtering step comprising:
filtering a plurality of packages according to at least one collection ID specified in the filtering criteria.

22. The method of claim 18, wherein the package identification data includes a version of each package, the filtering step comprising:
filtering a plurality of packages according to at least one package version specified in the filtering criteria.

23. The method of claim 14, wherein at least one group comprises a plan, each plan corresponding to one or more application programs.

24. The method of claim 23, wherein the identification data includes an owner of each plan, the filtering step comprising:

1 filtering a plurality of plans according to at least one plan owner specified
2 in the filtering criteria.

3
4 25. The method of claim 23, wherein the identification data includes a
5 name of each plan, the filtering step comprising:

6 filtering a plurality of plans according to at least one plan name specified in
7 the filtering criteria.

8
9 26. The method of claim 23, wherein the identification data includes a
10 database request module (DBRM) name for each plan, the filtering step comprising:

11 filtering a plurality of plans according to at least one DBRM name specified
12 in the filtering criteria.

13
14 27. The method of claim 14, further comprising:

15 displaying to a user those of the plurality of groups not excluded by the
16 filtering criteria.

17
18 28. An article of manufacture comprising a program storage medium
19 readable by a processor and embodying one or more instructions executable by the
20 processor to perform a method for filtering a plurality of groups of query statements
21 according to identification data associated therewith, each group corresponding to
22 one or more application programs posing queries to a database, the method
23 comprising:

24 receiving one or more user-specified filtering criteria directed to a subset of
25 the identification data; and
26

1 applying the filtering criteria to selectively exclude those of the plurality of
2 groups not satisfying the filtering criteria.

3
4 29. The article of manufacture of claim 28, the method further comprising:
5 receiving a user selection of one or more of the groups not excluded by the
6 filtering criteria for selectively filtering the query statements
7 associated with the selected groups according to user-defined filters
8 of query explain data.

9
10 30. The article of manufacture of claim 28, wherein the identification data
11 comprises data selected from the group consisting of owner data, name data,
12 collection ID data, and version data.

13
14 31. The article of manufacture of claim 28, the method further comprising:
15 obtaining the identification data for at least one group from a database
16 catalog.

17
18 32. The article of manufacture of claim 28, wherein at least one group
19 comprises a package, each package corresponding to one application program
20 posing queries to the database.

21
22 33. The article of manufacture of claim 32, wherein the identification data
23 comprises an owner of each package, the filtering step comprising:
24 filtering a plurality of packages according to at least one package owner
25 specified in the filtering criteria.
26

1 34. The article of manufacture of claim 32, wherein the identification data
2 comprises a name of each package, the filtering step comprising:

3 filtering a plurality of packages according to at least one package name
4 specified in the filtering criteria.
5

6 35. The article of manufacture of claim 32, wherein the identification data
7 includes a collection ID to which at least one package belongs, the filtering step
8 comprising:

9 filtering a plurality of packages according to at least one collection ID
10 specified in the filtering criteria.
11

12 36. The article of manufacture of claim 32, wherein the package
13 identification data includes a version of each package, the filtering step comprising:

14 filtering a plurality of packages according to at least one package version
15 specified in the filtering criteria.
16

17 37. The article of manufacture of claim 28, wherein at least one group
18 comprises a plan, each plan corresponding to one or more application programs
19 posing queries to the database.
20

21 38. The article of manufacture of claim 37, wherein the identification data
22 includes an owner of each plan, the filtering step comprising:

23 filtering a plurality of plans according to at least one plan owner specified
24 in the filtering criteria.
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39. The article of manufacture of claim 37, wherein the identification data includes a name of each plan, the filtering step comprising:
filtering a plurality of plans according to at least one plan name specified in the filtering criteria.

40. The article of manufacture of claim 37, wherein the identification data includes a database request module (DBRM) name for each plan, the filtering step comprising:
filtering a plurality of plans according to at least one DBRM name specified in the filtering criteria.

41. The article of manufacture of claim 37, the method further comprising:
displaying to a user those of the plurality of groups not excluded by the filtering criteria.

1 **SYSTEM AND METHOD FOR FILTERING QUERY STATEMENTS FROM**
2 **MULTIPLE PLANS AND PACKAGES ACCORDING TO USER-DEFINED**
3 **FILTERS OF QUERY EXPLAIN DATA**

4
5 **ABSTRACT OF THE DISCLOSURE**

6 An apparatus for filtering a plurality of groups of query statements
7 according to identification data associated therewith includes a processor for
8 executing instructions and a memory device having thereon modules of operational
9 data and executable code for execution by the processor. The modules include at
10 least one filtering module configured to receive one or more user-specified filtering
11 criteria directed to a subset of the identification data and apply the filtering criteria
12 to selectively exclude those of the plurality of groups not satisfying the filtering
13 criteria. The modules also include a group listing module configured to display to
14 a user those of the plurality of groups not excluded by the at least one filtering
15 module.

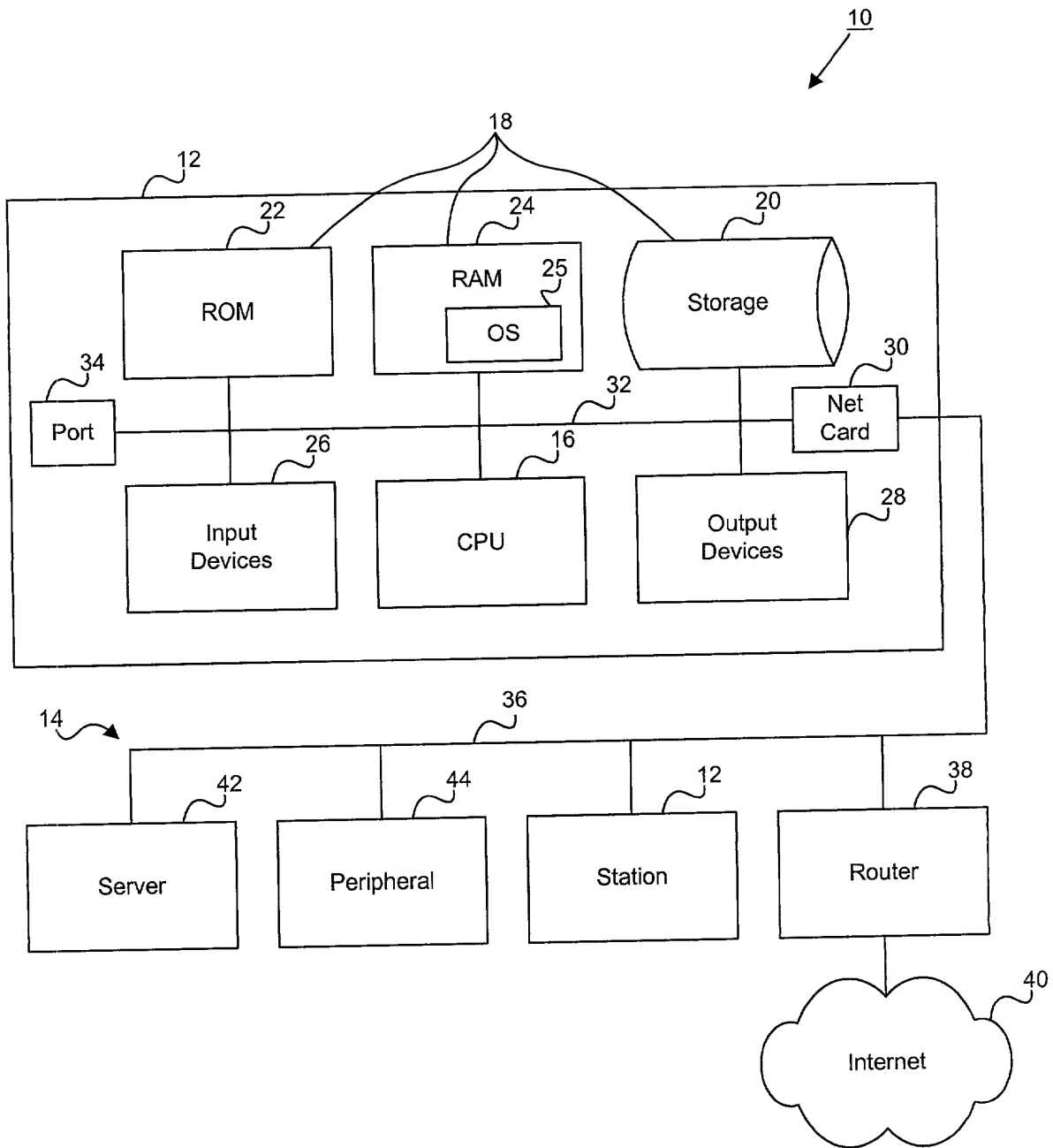


Fig. 1

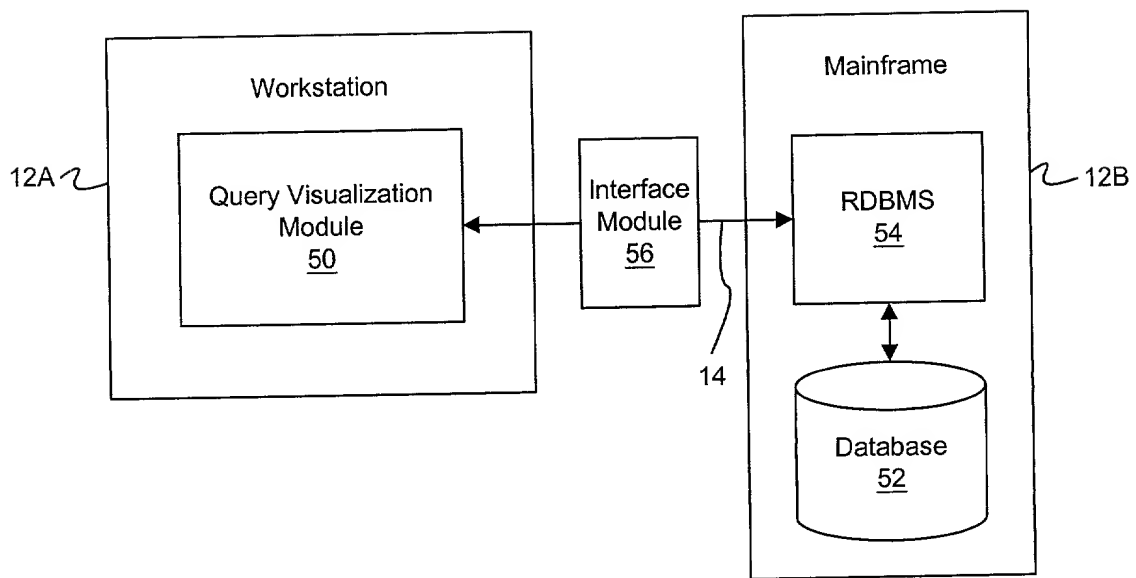


Fig. 2

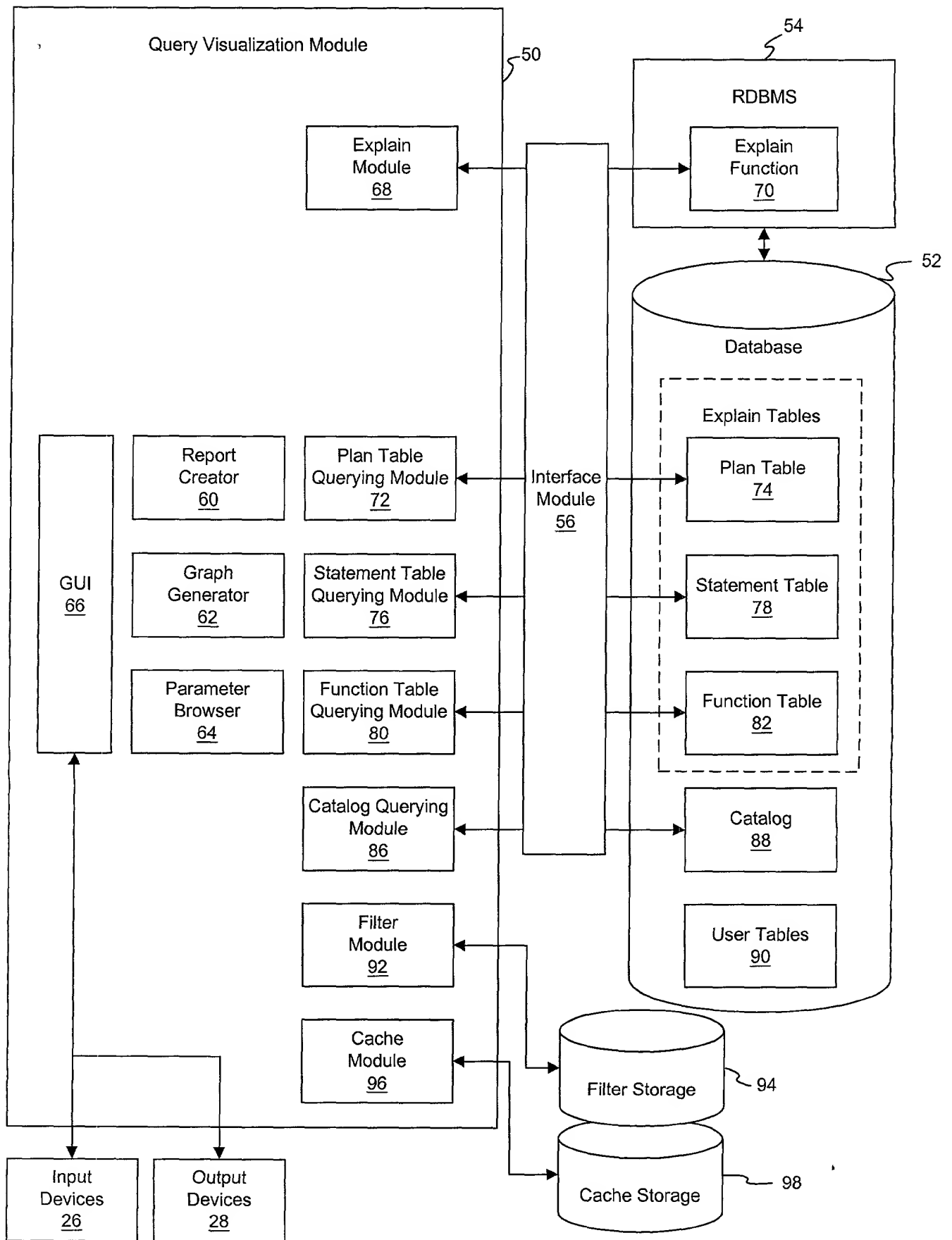
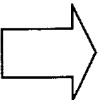


Fig. 3

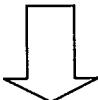
```

SELECT T1.NAME, T1.DEPT
FROM T1, T2, T3
WHERE T1.SALARY = T2.SALARY
AND T2.DEPT = T3.DEPT
AND T1.SALARY =
  (SELECT INCOME FROM T4
   WHERE LOCATION = STL)

```



RDBMS
54



74

QUERYNO	214	214	214	214	etc.
QBLOCKNO	1	1	1	2	
APPLNAME	PLAN1	PLAN1	PLAN1	PLAN2	
PROGNAME	DNSEMP1	DNSEMP1	DNSEMP1	DNSEMP1	
PLANNO	1	2	3	1	
METHOD	0	1	1	1	
TNAME	T1	T2	T3	T4	
TABNO	1	2	3	1	
ACCESSTYPE	I	I	I	R	
MATCHCOLS	1	1	1	1	
ACCESSNAME	IDX1	IDX2	IDX3	IDX4	
INDEXONLY	N	Y	Y		
SORTN_UNIQ	N	N	N	N	
SORTN_JOIN	N	N	N	N	
SORTN_ORDERBY	N	N	N	N	
SORTN_GROUPBY	N	N	N	N	
SORTC_UNIQ	N	N	N	N	
SORTC_JOIN	N	N	N	N	
SORTC_ORDERBY	N	N	N	N	
SORTC_GROUPBY	N	N	N	N	
PREFETCH	L				
MIXOPSEQ	0	0		0	
etc.					

Fig. 4

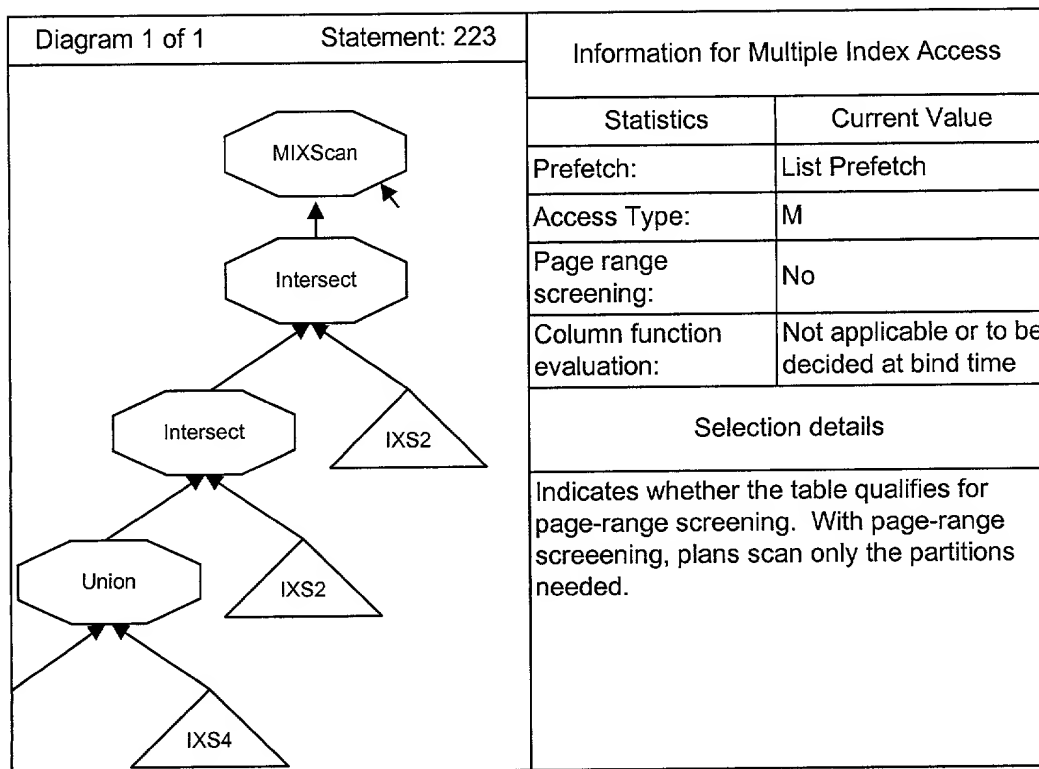


Fig. 5

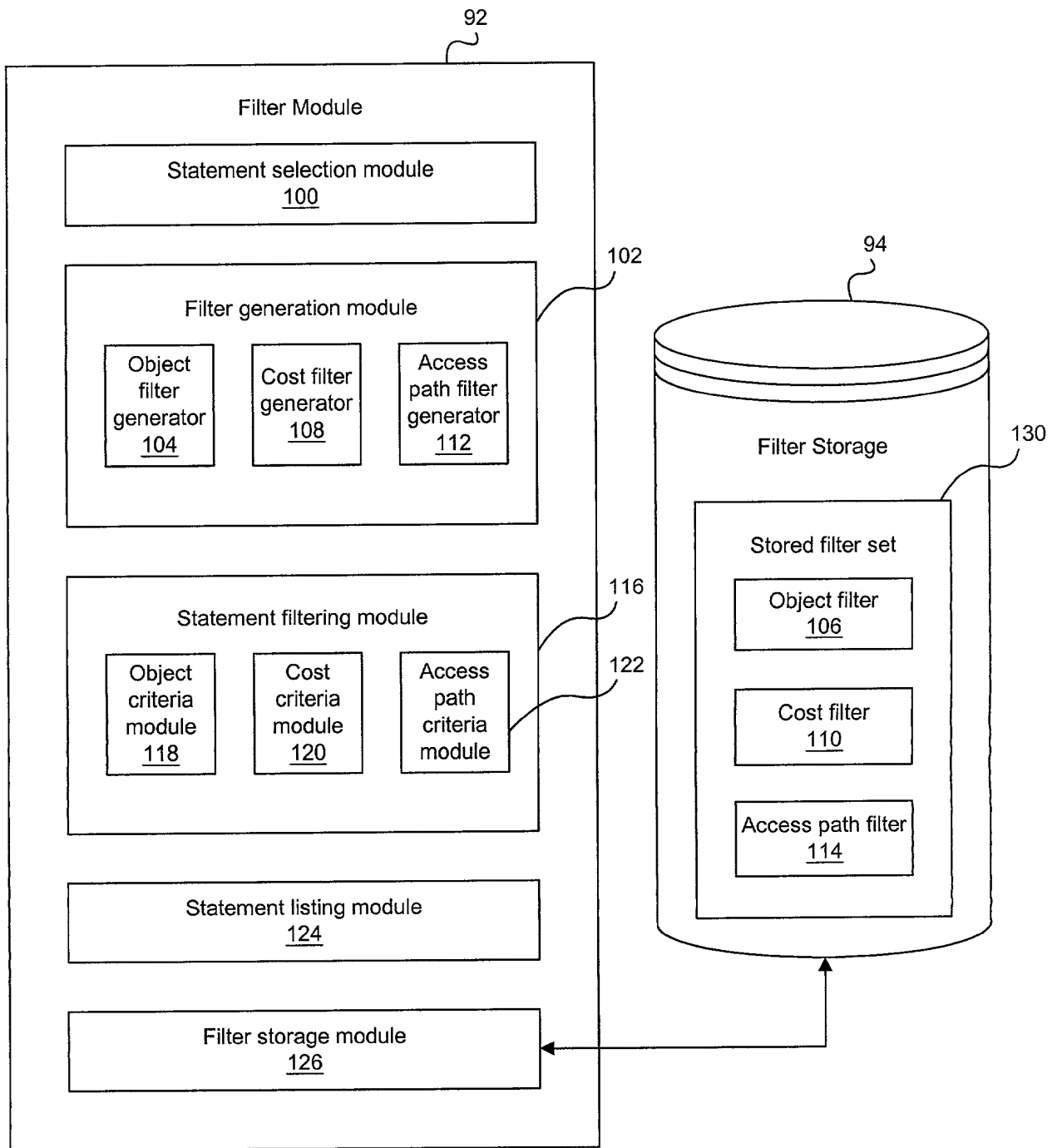


Fig. 6

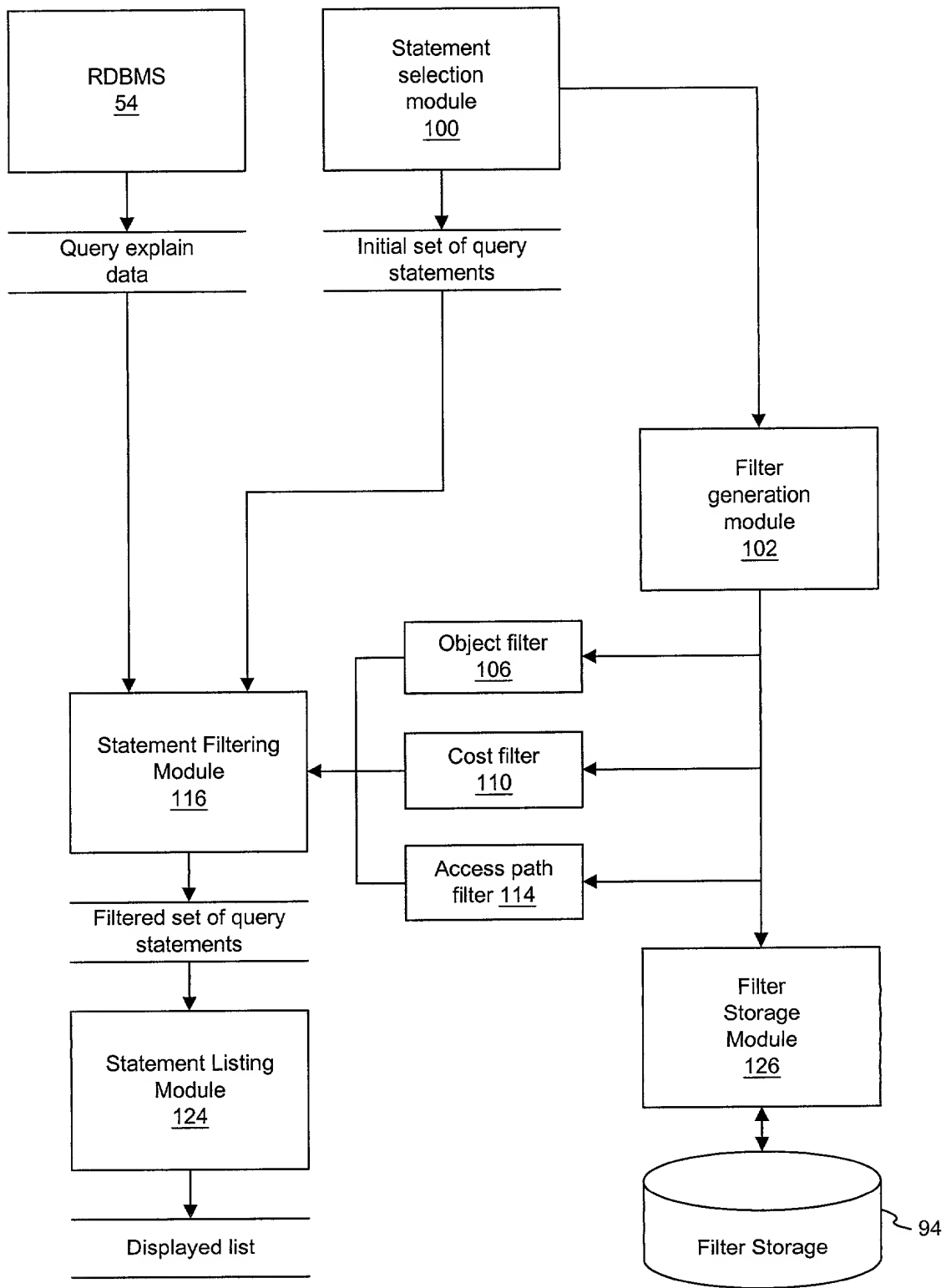


Fig. 7

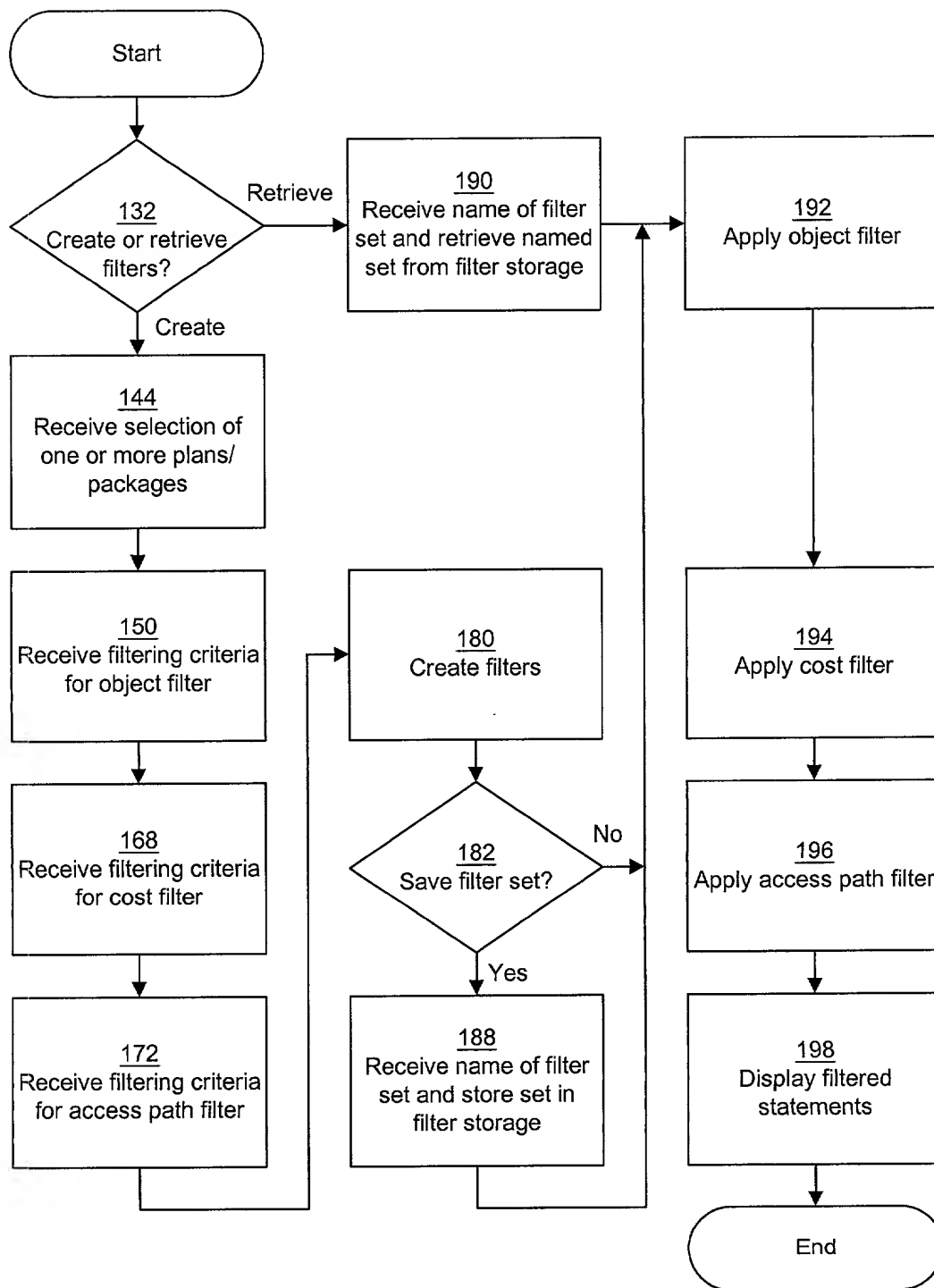
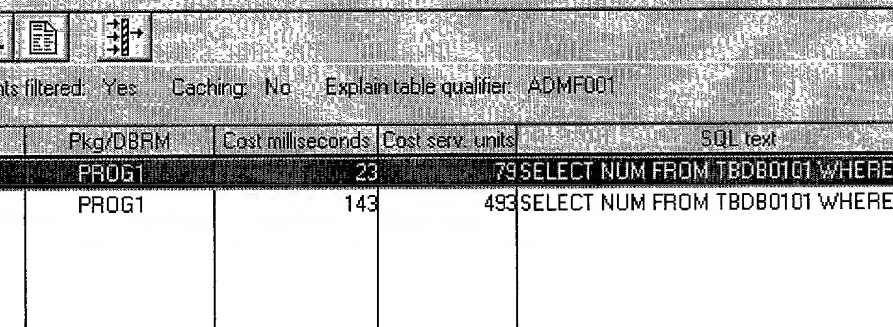


Fig. 8



Explainable Statements - V61A						
Statement View Help						
Statements filtered: No Caching: No Explain table qualifier: ADMF001						
Stmt	Pkg/DBRM	Cost milliseconds	Cost serv. units	SQL text	Collection id	Plan name
212	PROG1	23		79 SELECT NUM FROM TBDB0101 WHERE NUM > 971 ORDER BY		PLAN1
216	PROG1	143		493 SELECT NUM FROM TBDB0101 WHERE NUM > 971		PLAN1
269	PROG1	48		164 SELECT NUM INTO · H · H FROM TBDB0102 WHERE STR = 'K		PLAN1
280	PROG1	226412		783432 SELECT A · NUM INTO · H · H FROM TBDB0102 A , TBDB0103		PLAN1
217	PROG4	581		2011 SELECT * FROM VIEW1		PLAN4
220	PROG4	1		1 SELECT MAX (VC1) FROM VIEW2		PLAN4
212	PROG2	1096		3791 SELECT QUERYNO FROM PLAN_TABLE UNION ALL SELECT QPACK2		AD
218	PROG2	1637		5663 SELECT QUERYNO FROM PLAN_TABLE UNION SELECT QPACK2		AD
224	PROG2	795		2750 SELECT A · NAME , COALESCE (E · NAME , 'MISSING') AS OLDPACK2		AD
292	PROG2	48		164 SELECT NUM INTO · H · H FROM TBDB0102 WHERE STR = 'K		AD

Fig. 11



The screenshot shows a window titled "Explainable Statements - V61A". Below the title bar is a menu bar with "Statement", "View", and "Help". Under "Statement", there are icons for a network, "SQL", a document, and a list with an arrow. Below the menu bar, it says "Statements filtered: Yes", "Caching: No", and "Explain table qualifier: ADMF001". The main area contains a table with the following data:

Stmt	Pkg/DBRM	Cost milliseconds	Cost serv. units	SQL text
212	PROG1	23	79	SELECT NUM FROM TBDB0101 WHERE NUM :
216	PROG1	143	493	SELECT NUM FROM TBDB0101 WHERE NUM :

Fig. 13

Explainable Statements - V61A				
Statement View Help				
Statements filtered: Yes Caching: No Explain table qualifier: ADMF001				
Stmt	Pkg/DBRM	Cost milliseconds	Cost serv. units	SQL text
280	PROG1	226412	783432	SELECT A. NUM INTO :H :H FROM T
212	PROG2	1096	3791	SELECT QUERYNO FROM PLAN_TABI
218	PROG2	1637	5663	SELECT QUERYNO FROM PLAN_TABI

Fig. 15

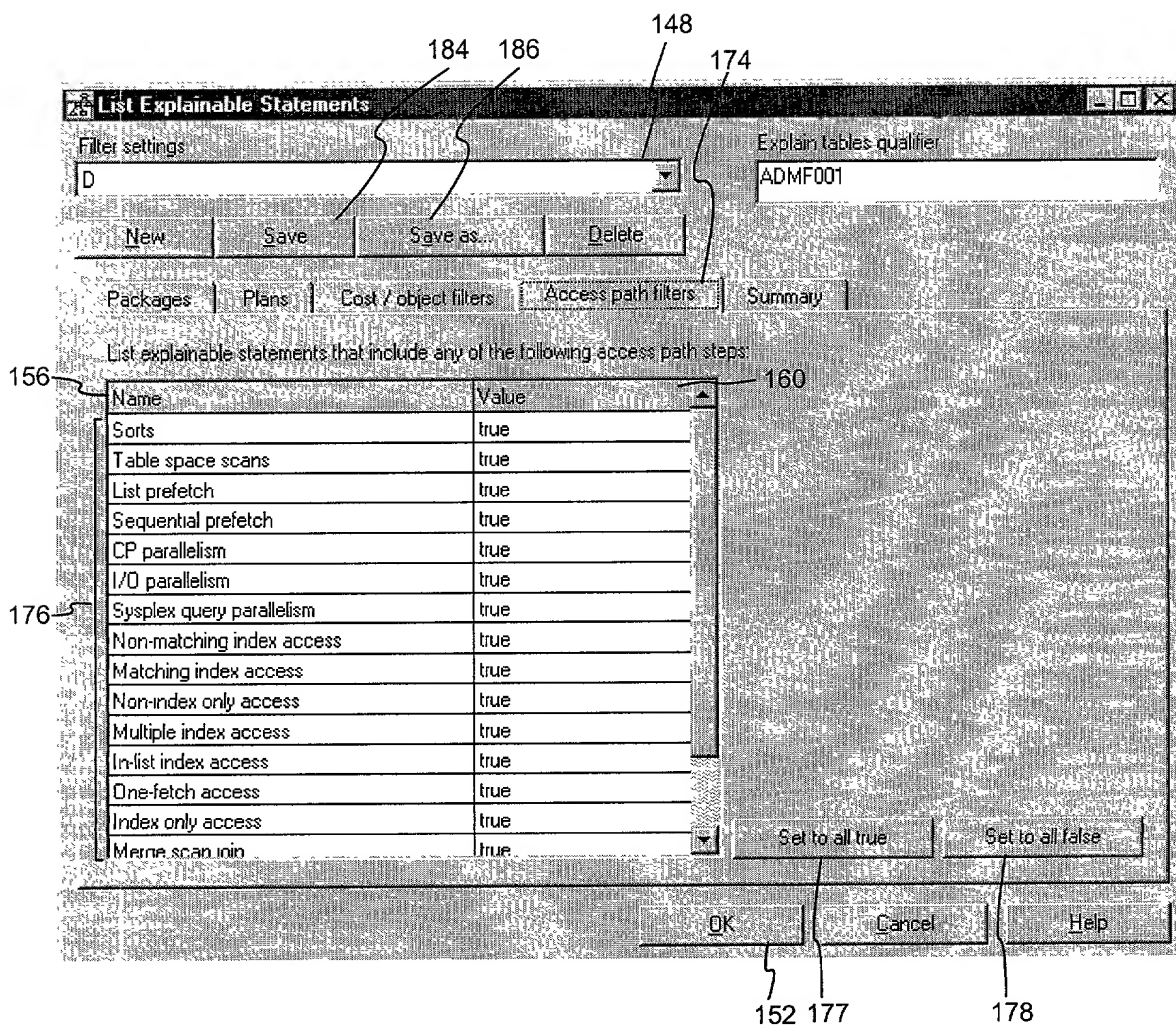


Fig. 16

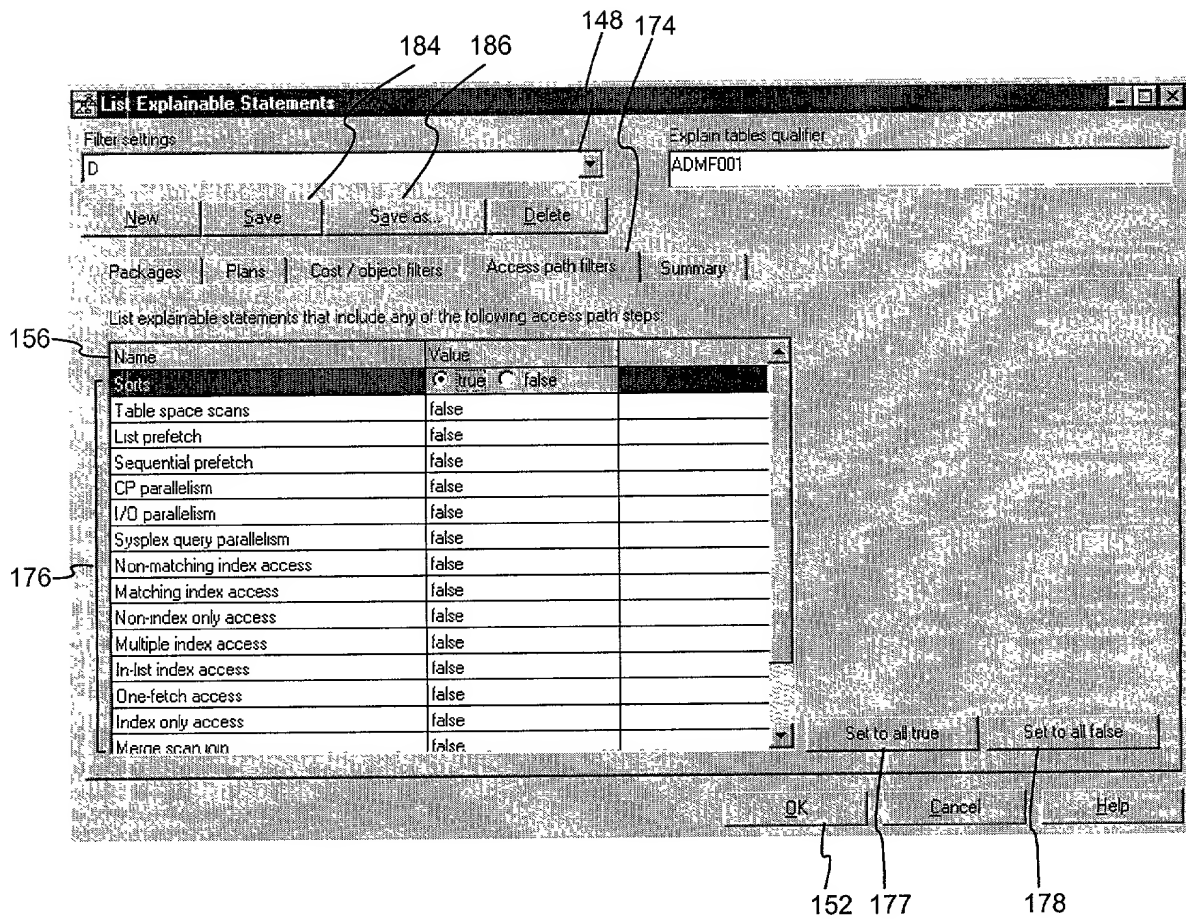


Fig. 17

Explainable Statements - V61A

Statement View Help

Statements filtered: Yes Caching: No Explain table qualifier: ADMF001

Stmt	Pkg/DBRM	Cost milliseconds	Cost serv. units	SQL text	Collect
220	PROG4	1	1	SELECT MAX { VC1 } FROM VIEW2	
218	PROG2	1637	5663	SELECT QUERYNO FROM PLAN_TABLEPACK2	

Fig. 18

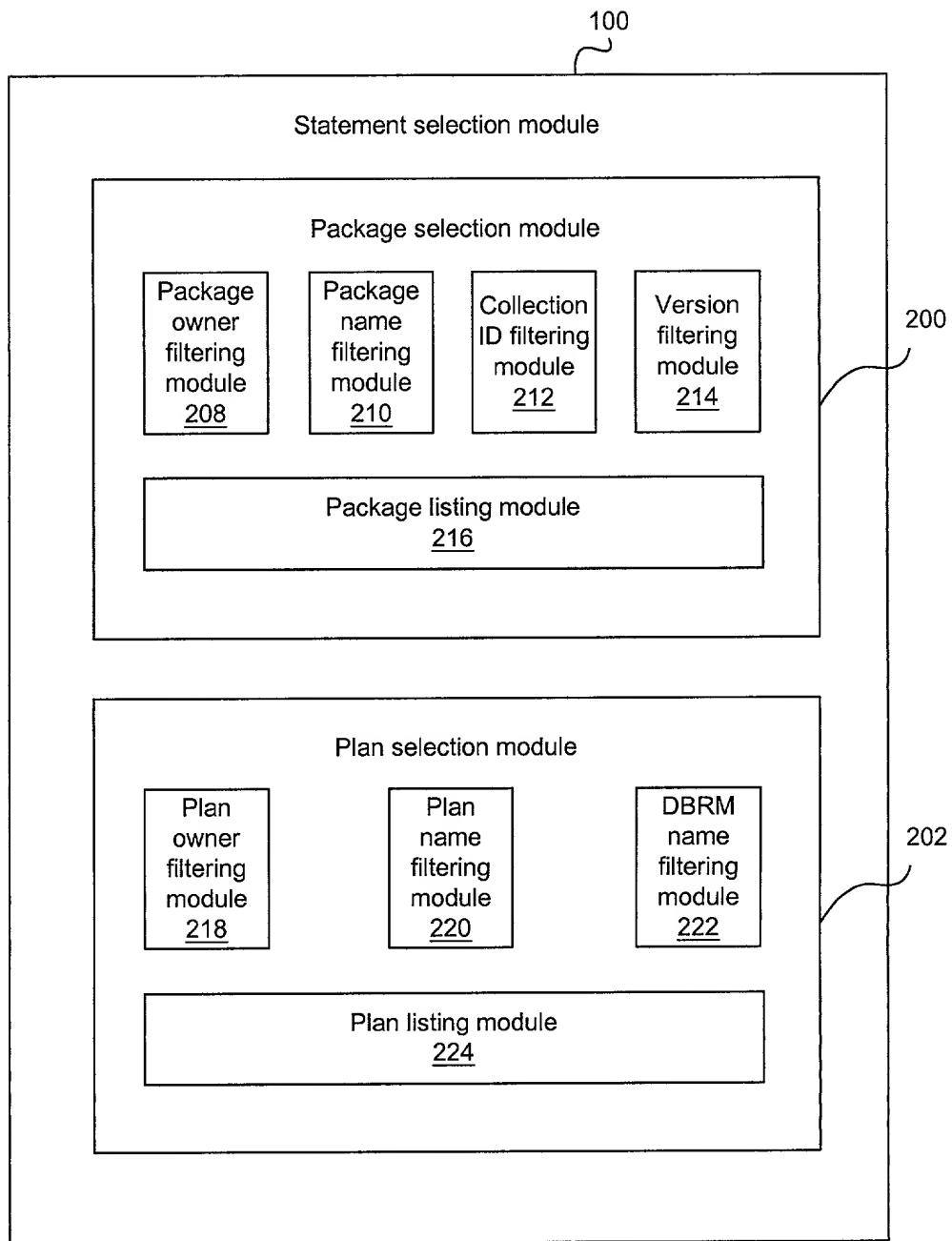


Fig. 19

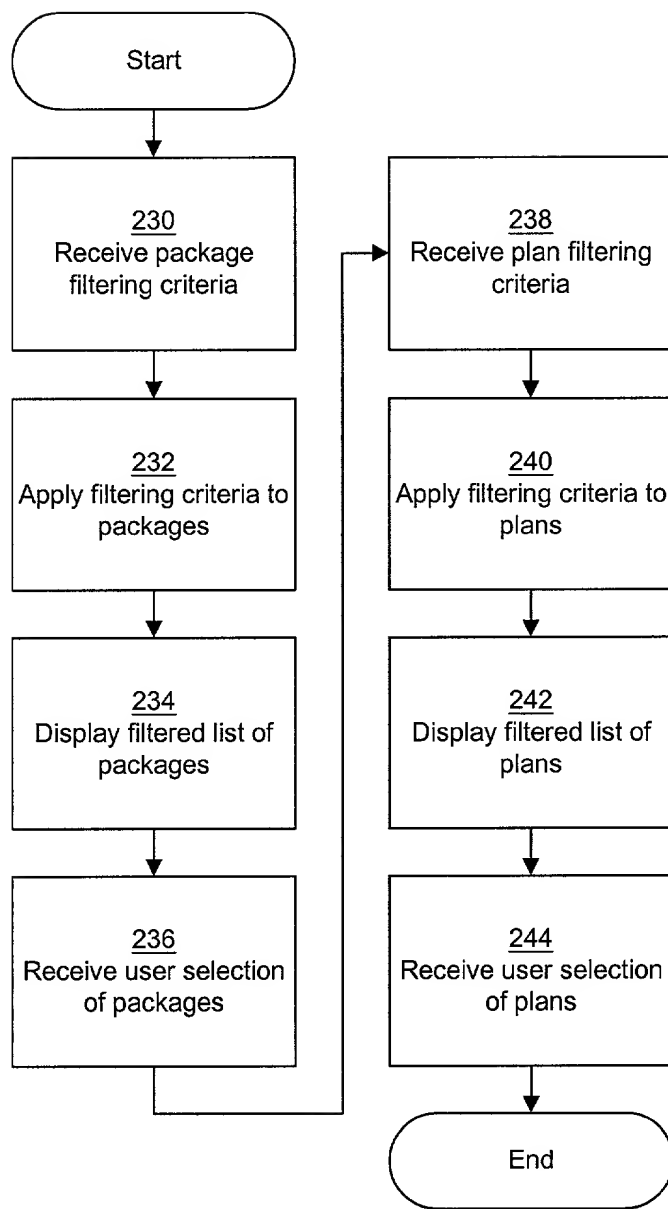


Fig. 20

Fig. 21

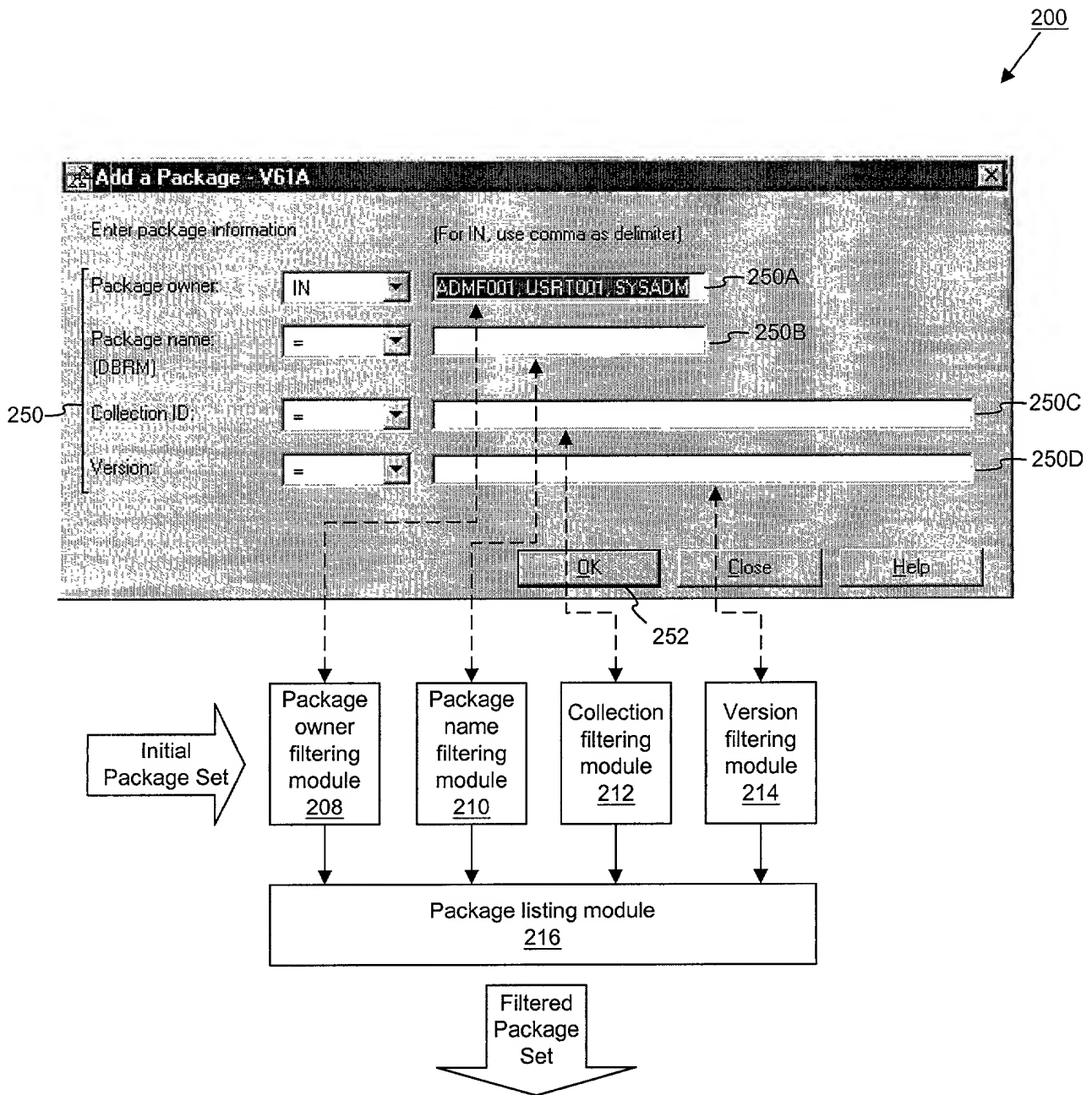


Fig. 22

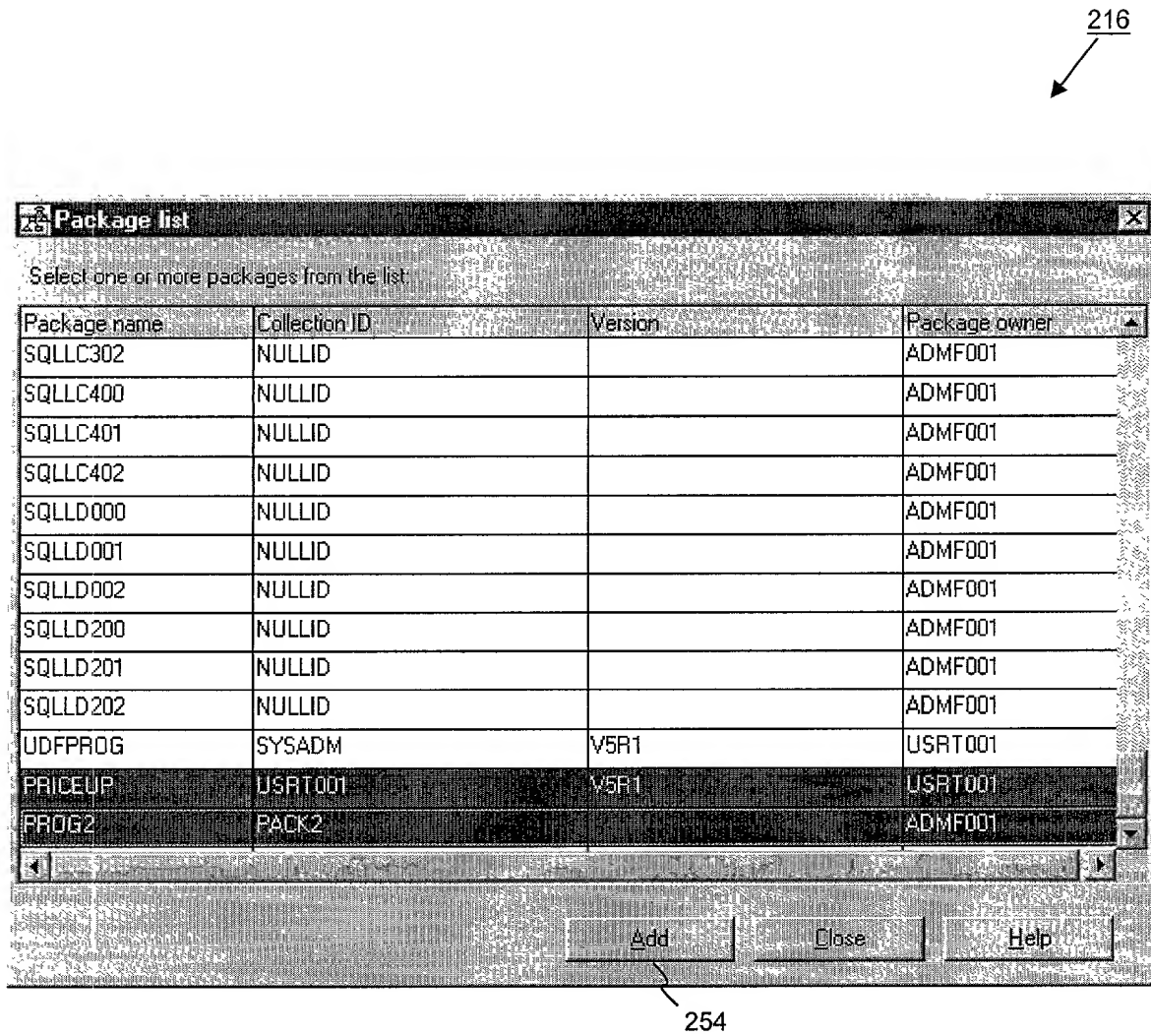


Fig. 23

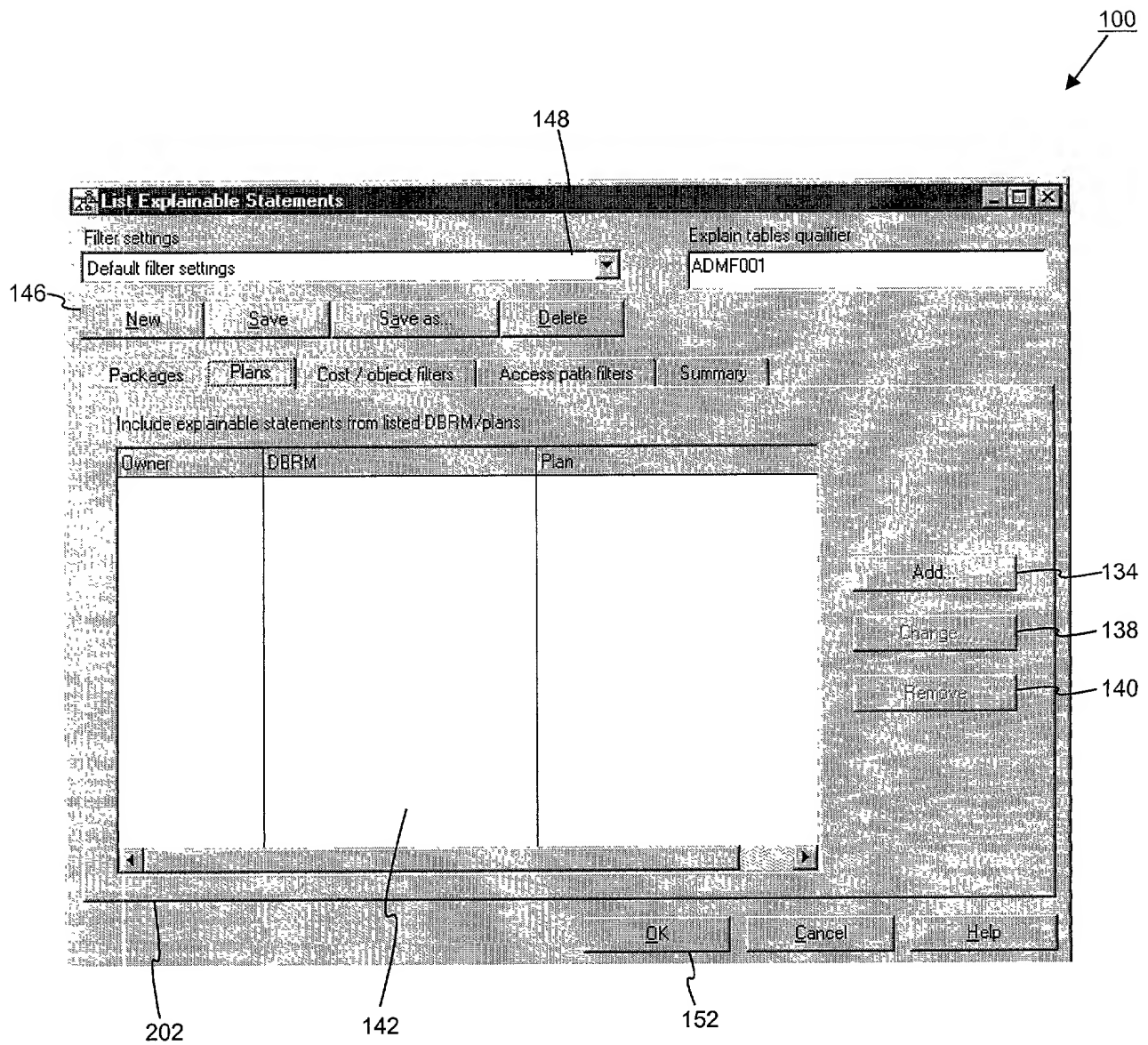


Fig. 25

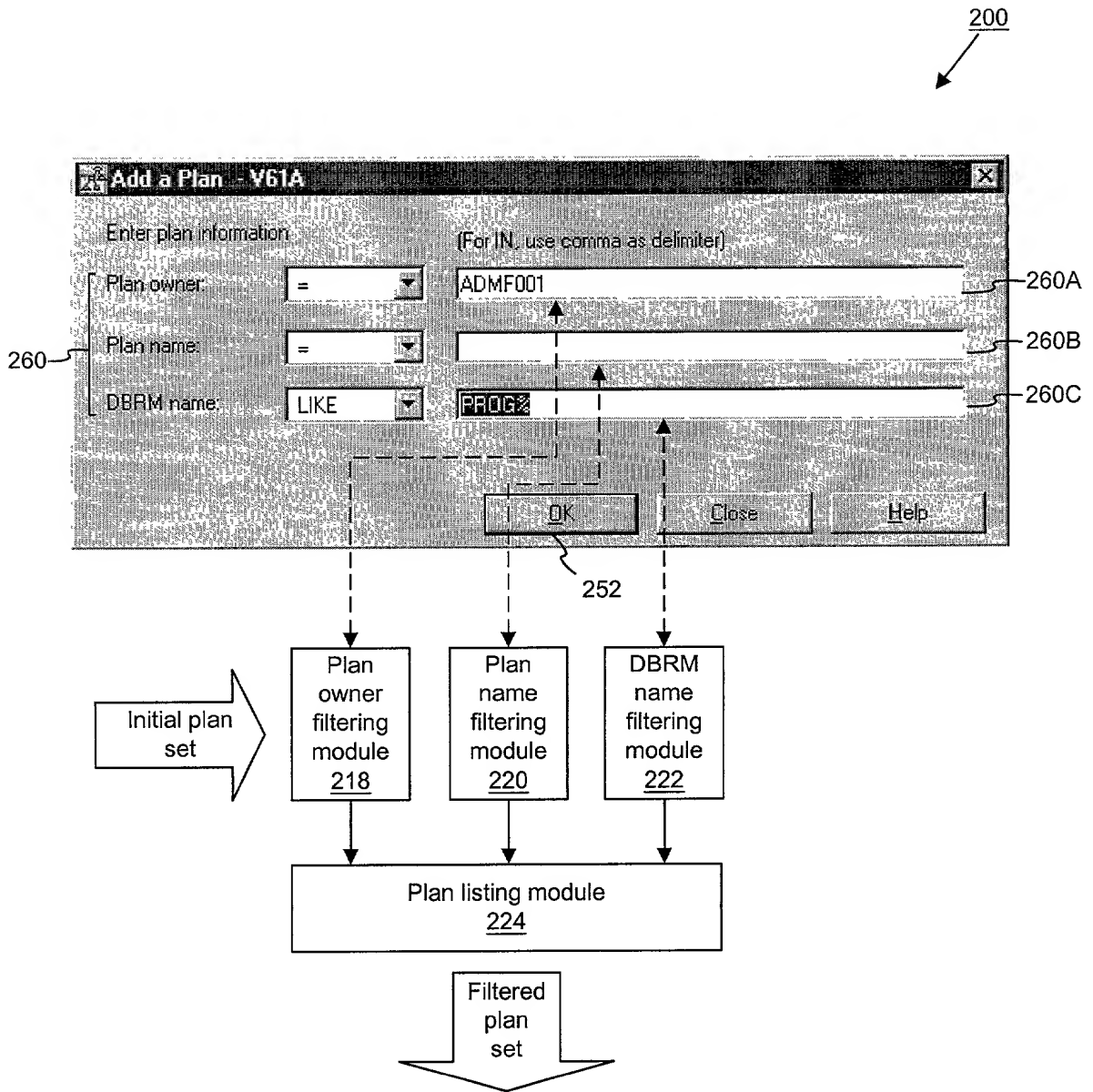


Fig. 26

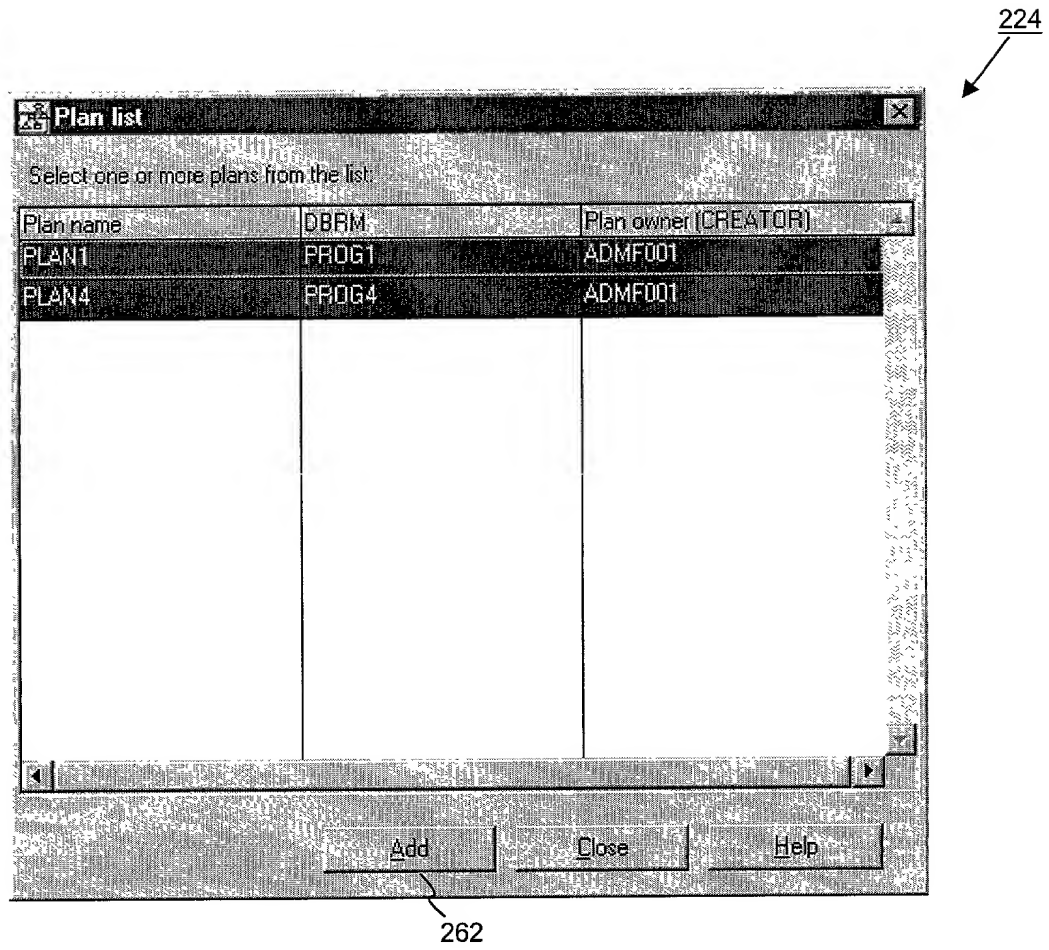


Fig. 27

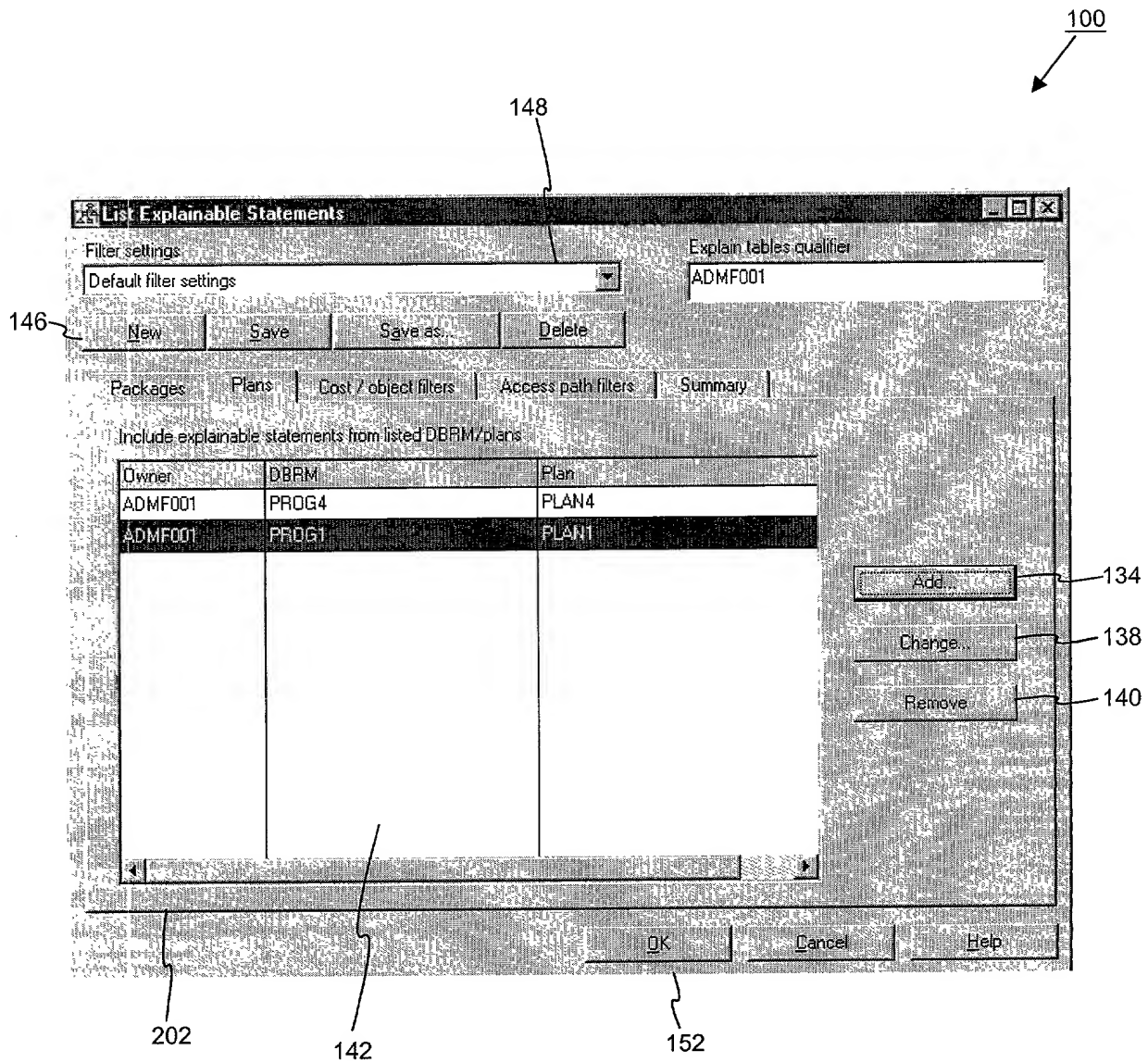


Fig. 28

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence and citizenship are as stated below next to my name;

I believe I am the original , first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled

SYSTEM AND METHOD FOR FILTERING QUERY STATEMENTS FROM MULTIPLE PLANS AND PACKAGES ACCORDING TO USER-DEFINED FILTERS OF QUERY EXPLAIN DATA

the specification of which (check one)

 X is attached hereto.
 was filed on _____
as Application Serial No. _____
and was amended on _____ (if applicable).

I hereby stat that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, united States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed
<u> none </u>	<u> </u>	<u> </u>	<u> </u> Yes <u> </u> No
(Number)	(Country)	(Day/Month/Year filed)	

I hereby claim the benefit under Title 35, Untied States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56, which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

<u>08/949,636</u>	<u>October 14, 1997</u>	<u>Pending</u>
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Docket Number: ST9-99-115

POWER OF ATTORNEY: As named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

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 Ingrid M. Foerster: 36,511
 Prentiss W. Johnson: 33,123
 Christopher A. Hughes: 26,914
 John E. Hoel: 26,279
 Edward A. Pennington: 32,588
 Joseph C. Redmond, Jr.: 18,753
 Craig J. Madson: 29,407
 L. Craig Metcalf: 31,398

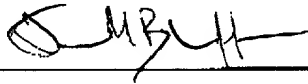
Evan R. Witt: 32,512
 A. John Pate: 36,234
 Gary D.E. Pierce: 38,019
 David B. Fonda: 39,672
 John R. Thompson: 40,842
 Brian C. Kunzler: 38,527
 Barton W. Giddings: 41,036
 Hal D. Baird: 42,284
 Kory D. Christensen: 43,548

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Inventor's signature:



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1-7-2000

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Inventor's signature:

Date:

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Citizenship: United States of America

Post Office Address: Same

POWER OF ATTORNEY: As named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

Romualdas Strimaitis:	32,577	Evan R. Witt:	32,512
Timothy M. Farrell:	37,321	A. John Pate:	36,234
Ingrid M. Foerster:	36,511	Gary D.E. Pierce:	38,019
Prentiss W. Johnson:	33,123	David B. Fonda:	39,672
Christopher A. Hughes:	26,914	John R. Thompson:	40,842
John E. Hoel:	26,279	Brian C. Kunzler:	38,527
Edward A. Pennington:	32,588	Barton W. Giddings:	41,036
Joseph C. Redmond, Jr.:	18,753	Hal D. Baird:	42,284
Craig J. Madson:	29,407	Kory D. Christensen:	43,548
L. Craig Metcalf:	31,398		

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Date:

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Docket Number: ST9-99-115

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